AVIATION WEEK

A McGRAW-HILL PUBLICATION

JUNE 18, 1956 50 cents

Motivation: Management's Spur For Engineers

Cessna T-37A

Air Transport Seminar On Jet Ground Problems

Tail Thrust Reverser Cuts Jet Landing Run in Half

WIGGINS' NEWEST!

an automatic connection

SMALL SPACE REQUIREMENT

LOW PRESSURE DROP

NO AIR INCLUSION

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COUPLING

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POSITIVE

SAFE AND DOUBLE SAFE

ANY DESIRED SERVICE

PUSH...it's connected!

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E. B. WIGGINS OIL TOOL COMPANY, INC.
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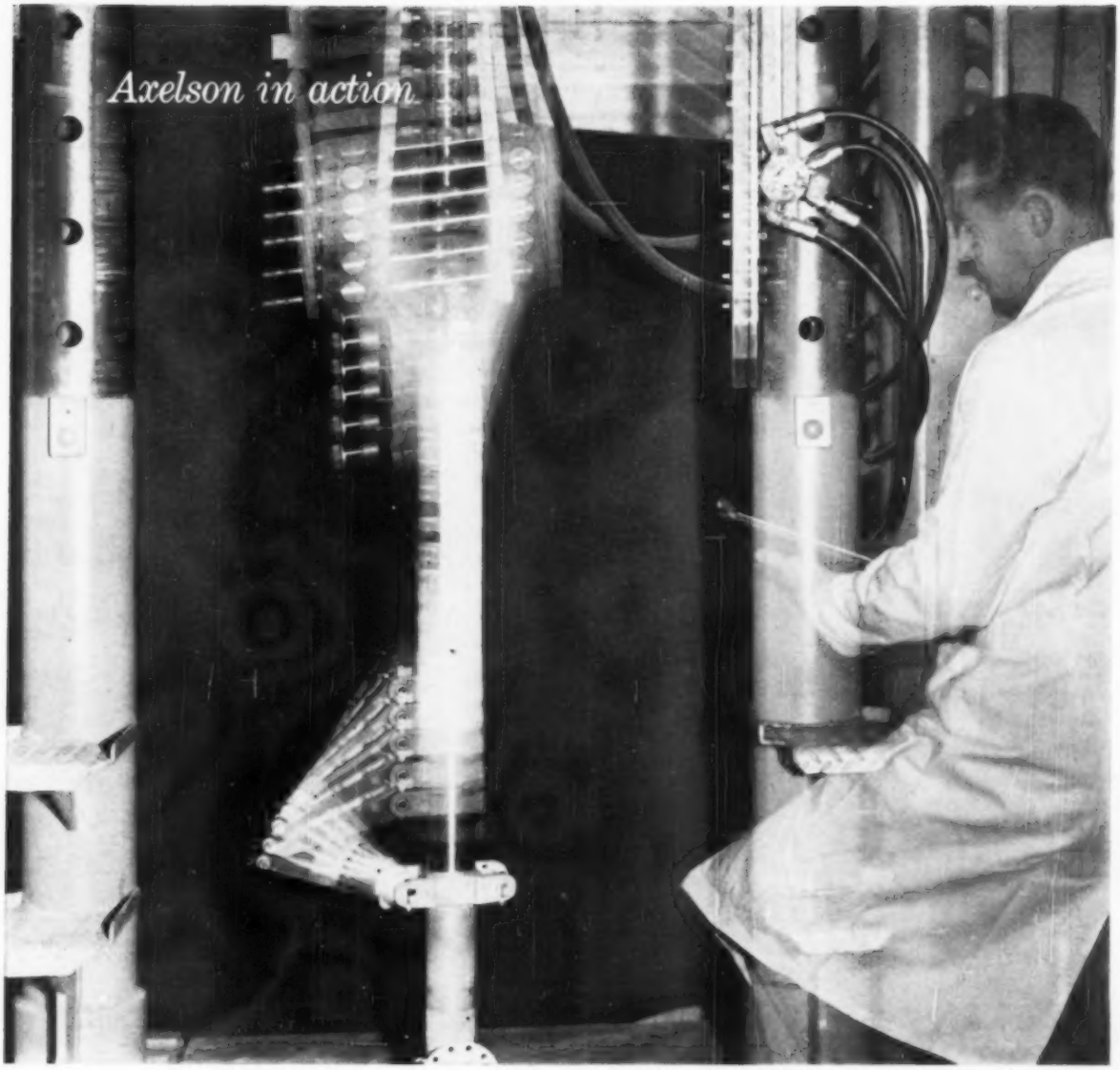

Functional testing of Axelson landing gear for North American T-28.

defense takes the stand

Aircraft landing gears for America's defense are subjected to a brutal third degree on an Axelson test stand . . . one phase of Axelson's unusually thorough test program, which includes meticulous investigation during development, inspection at each stage of fabrication and assembly, and rigorous operational testing before delivery.

Every Axelson product must prove its ability to stand up and take it under conditions that far exceed design specifications. Each demonstrates, again and again, there is no substitute for Axelson experience that has produced landing gears, shock struts, spars, geared mechanisms and hydraulic units for aircraft such as the B-52, B-47, A3-D, A4-D, F4-D, T-28 and B-57.

With Axelson's insistence on *proven* quality and performance . . . the defense rests.

AXELSON

Axelson Manufacturing Company

AIRCRAFT

Division of U. S. Industries, Inc.

6160 South Boyle Avenue, Los Angeles 58, California

World's Fastest Navy Fighter

9 Proudly wears Sargent controls

Nine Sargent quality units have been selected to provide Chance Vought's F8U-1 Crusader with instantaneous, positive, feathertouch response.

These units, Sargent fabricated to Vought specifications, provide a system for control for the safe, positive, efficient operation of this great fighter.

The experience of more than 36 years of design and manufacture of precision equipment systems has given Sargent Engineering Corporation the "know-how" to aid in solving the essential and advance problems of force control. Leading airframe and missile manufacturers are using hundreds of different Sargent hydraulic, mechanical, pneumatic, electrical and electronic force control units on the nation's military planes, commercial planes and missiles.

Sargent places its facilities of design and manufacture at your disposal. We invite you to send your specifications for the Sargent proposal of your force control problems.

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"GOOD WILL" to the disposition of the pleased customer to return to the place where he has been well treated.

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BUILDS QUALITY THAT BUILDS GOOD WILL

AVIATION CALENDAR

June 18-21—National summer meeting of the Institute of Aeronautical Sciences, 7660 Beverly Blvd., Los Angeles.

June 19—Council of the International Civil Aviation Organization, 10th session, Caracas, Venezuela.

June 20-22—Aviation Distributors and Manufacturers Assn., 27th meeting, Grove Park Inn, Asheville, N. C.

June 25-27—High Temperature Symposium, Berkeley Campus, University of California.

June 28-30—Institute of Navigation's 12th annual national conference, Hotel Miramar, Santa Monica, Calif.

June 30—Jet Age Conference, Sheraton-Jefferson Hotel, St. Louis, Mo.

July 7-10—Tenth annual All-Woman Transcontinental Air Race (Powder Puff Derby), San Mateo County Airport, Calif. to Flint, Mich. Entries close June 20. For details write: Mrs. Betty M. Loufek, Loufek & London, 2611 E. Spring St., Long Beach 6, Calif.

July 8—Third annual Western New York Air Show and Races, Niagara Falls Municipal Airport, Niagara Falls, N. Y.

July 15-30—World Parachuting Championship, Moscow, Russia.

July 31-Aug. 9—23rd Annual U. S. National Soaring Competitions, **Aug. 5**—Air Show, Grand Prairie Airport, Grand Prairie, Texas.

Aug. 1-5—Air Force Association's 1956 National Convention and Airpower Panorama, Roosevelt Hotel, New Orleans, La.

Aug. 6-8—Society of Automotive Engineers National West Coast Meeting, Mark Hopkins Hotel, San Francisco, Calif.

Aug. 15-17—Institute of the Aeronautical Sciences, National Turbine-Powered Air Transportation Meeting, Grant Hotel, San Diego, Calif.

Aug. 21-24—Western Electronic Show & Convention, Pan Pacific Auditorium and Ambassador Hotel, Los Angeles.

Aug. 22-24—Bendix Aviation Corp.'s 1956 International Ignition Conference, Sidney, New York.

Aug. 27-29—Association for Computing Machinery, University of California Westwood Campus, Los Angeles.

AVIATION WEEK • JUNE 18, 1956
Vol. 64, No. 25

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MALLORY-SHARON reports on

TITANIUM

World's fastest flies with MALLORY-SHARON titanium

• Performance details on the U.S. Air Force's new Lockheed F-104 are classified. But one thing can be said: all metals—including titanium supplied by Mallory-Sharon—used in this advanced aircraft have met the most stringent requirements.

Mallory-Sharon, one of the leading producers of titanium and titanium alloy mill products, has paced many improvements in the metal which account for its rapid growth and acceptance today. Such things as certification of physical properties, guarantee of optimum machineability, development of heat treatable alloys, and so on.

If you use titanium, you can depend on proved quality with Mallory-Sharon. If you don't yet use titanium, isn't it time you investigated this strong, lightweight, corrosion-resistant metal? Call us for your requirements.

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- SPEED ASSEMBLY
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Long experience in designing fasteners and allied devices for leading aircraft manufacturers enables Monadnock to bring a wealth of specialized skill to bear on *your* particular fastening problems.

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WEDJIT — Seat and cargo tie-down fastener

AIRLOC STUD with nylon sealing ring fits standard Airloc

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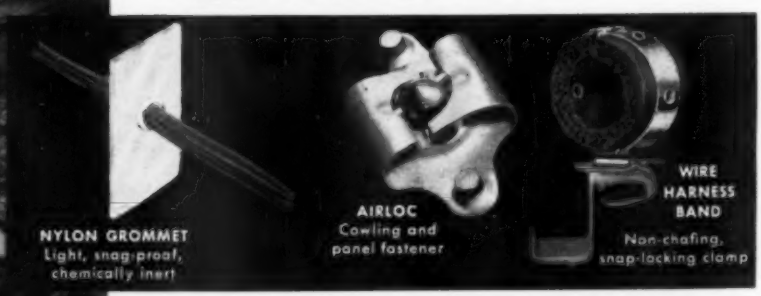
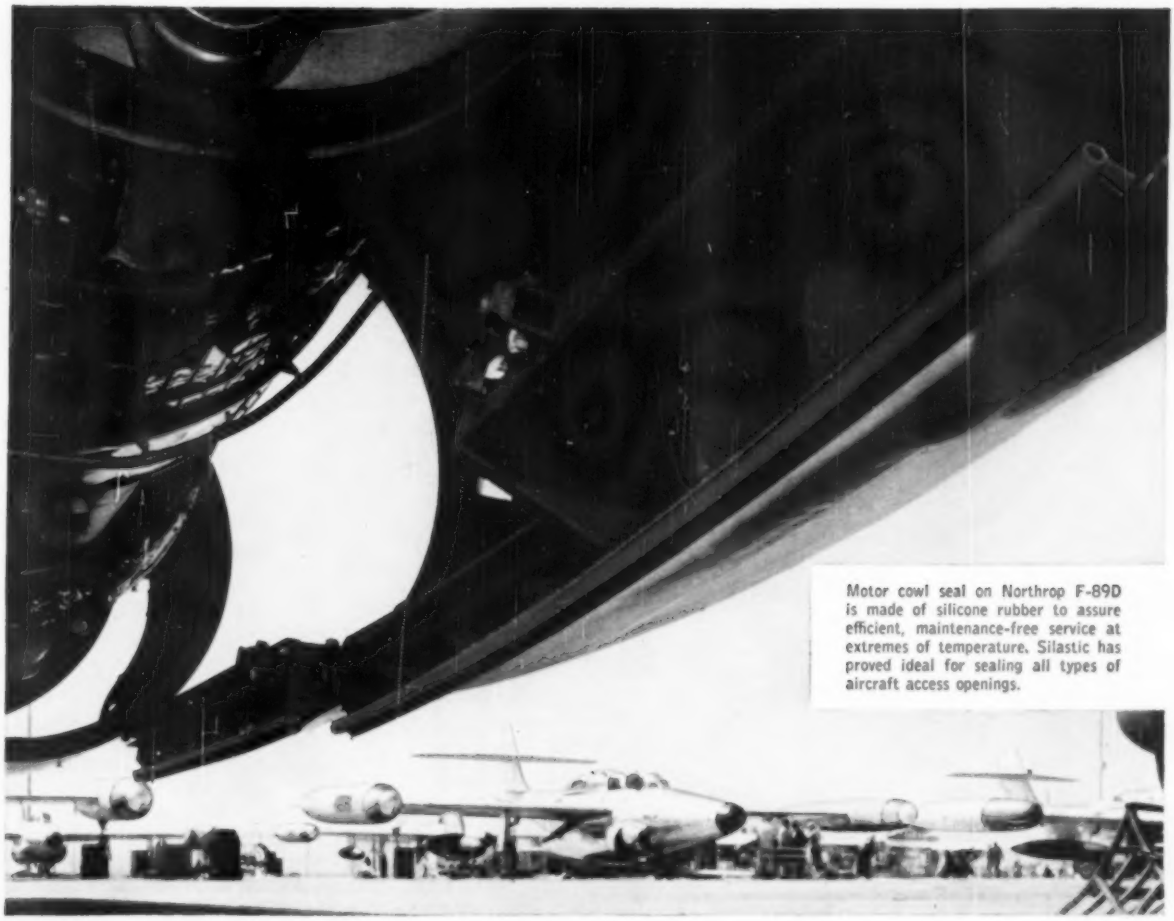


NYLON GROMMET Light, snag-proof, chemically inert

AIRLOC Cowling and panel fastener

WIRE HARNESS BAND Non-chafing, snap-locking clamp

Subsidiary of **UNITED-CARR FASTENER CORP.**



Motor cowl seal on Northrop F-89D is made of silicone rubber to assure efficient, maintenance-free service at extremes of temperature. Silastic has proved ideal for sealing all types of aircraft access openings.

SILASTIC seals stay efficient from –130 to 500 F

SILICONE RUBBER

Silastic*, Dow Corning's silicone rubber, adds efficiency and dependability to your product because it stays resilient and keeps its shape at temperatures which quickly destroy the effectiveness of organic rubber. Available through leading rubber companies in practically any color, size or shape—sponged, solid or hollow.

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Typical Properties of Silastic for Seals

• Temperature range, °F	–130 to 500
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• Elongation, %	150 to 300
• Tear strength, lb/in	40 to 75
• Compression set, %, @ 300 F	25 to 50
• Hardness range, Durometer	20 to 80
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If you consider ALL the properties of a silicone rubber, you'll specify SILASTIC.

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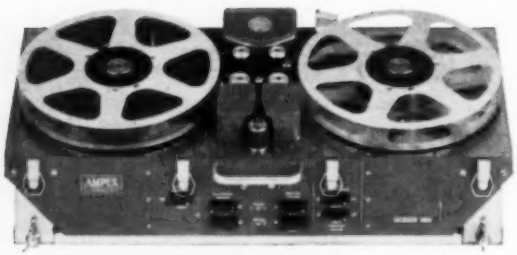
AMPEX 800

THE MAGNETIC RECORDER YOU CAN SPECIFY WITH CONFIDENCE



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Navy Radiological Defense Lab
Naval Air Development Center, Johnsville
Naval Ordnance Lab

Other:
Sandia Corporation
R C A
Cambridge Research Center
Radioplane
Texas University
Bell Telephone Labs
Federal Telecommunications Labs
General Electric Co.
Airborne Instruments

This installation of an Ampex 800 Airborne Magnetic Recorder in an F-80 at Edwards Airforce Base is at the heart of a major project for developing faster data recording and reduction techniques. Over twenty aircraft companies, government test facilities and others have also purchased Ampex 800s and received delivery in quantity during its first year of production.

The Ampex 800 has had quick acceptance because it has lived up to promise. When the model was publicly announced, it was already a completed and tested design. The Ampex 800 was backed by more experience in magnetic tape instrumentation than exists anywhere else in the world. It was ready to perform with utmost reliability. It was capable of recording the entire flight test data on a single tape. And on a production basis it met specifications in all details.

For full information and specifications, write Dept. UU-2757

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FIRST IN MAGNETIC TAPE INSTRUMENTATION

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Wright cranes keep engines flying through world's largest line-maintenance hangar

...with the help of 384 TIMKEN® bearings

24 motor-driven Wright cranes like the one shown keep engines winging from station to station in the world's largest line-maintenance hangar at Miami. And keeping the cranes on the go are 384 Timken® tapered roller bearings on the bridge wheels and trolley wheels.

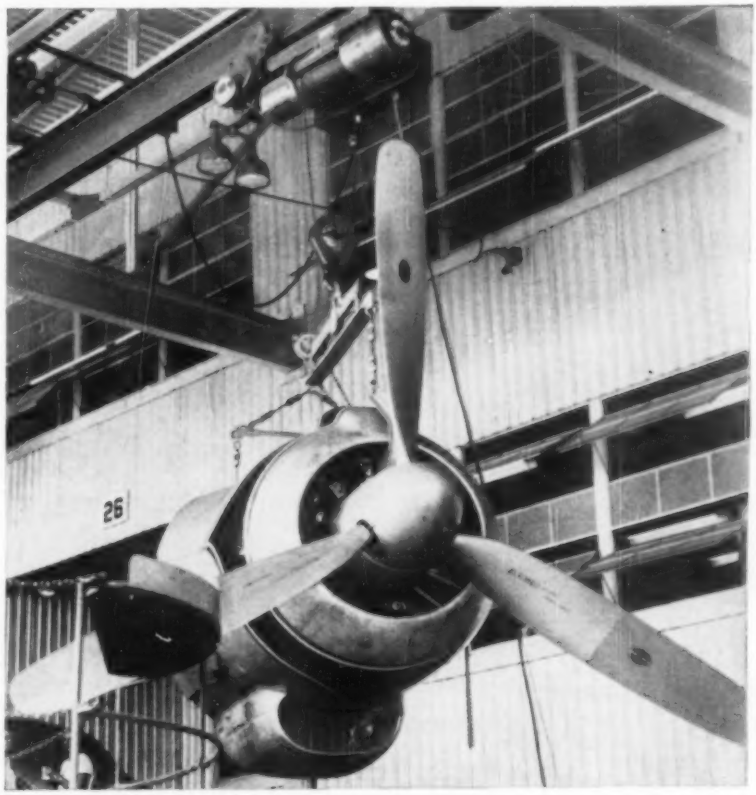
Timken bearings take both the radial loads imposed by the weight of the engines and the thrust loads set up by the pendulum motion of crane operation. The tapered design of Timken bearings lets them take radial and thrust loads in any combination. And full line contact between rollers and races gives these bearings extra load-carrying capacity. Downtime is cut, cranes are kept on the go.

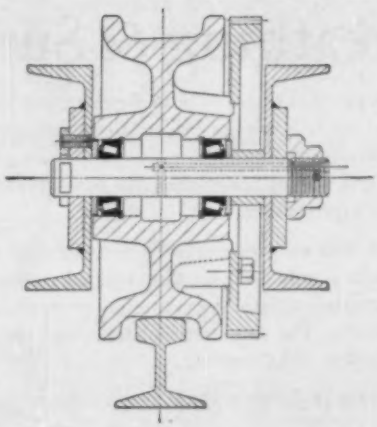
Friction is virtually eliminated with Timken bearings. They're designed by geometric law to have true rolling motion—precision manufactured to live up to their design. Cranes roll smoothly with a minimum of wear and maintenance. And to take the shock loads often encountered, rollers and races of Timken bearings are case-carburized to give them wear-resistant surfaces over tough, shock-resistant cores.

Be sure you specify Timken bearings when you build or buy a machine. To give you the *finest* roller bearings, we even make our own fine alloy steel. We're America's only bearing manufacturer that does.

Look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



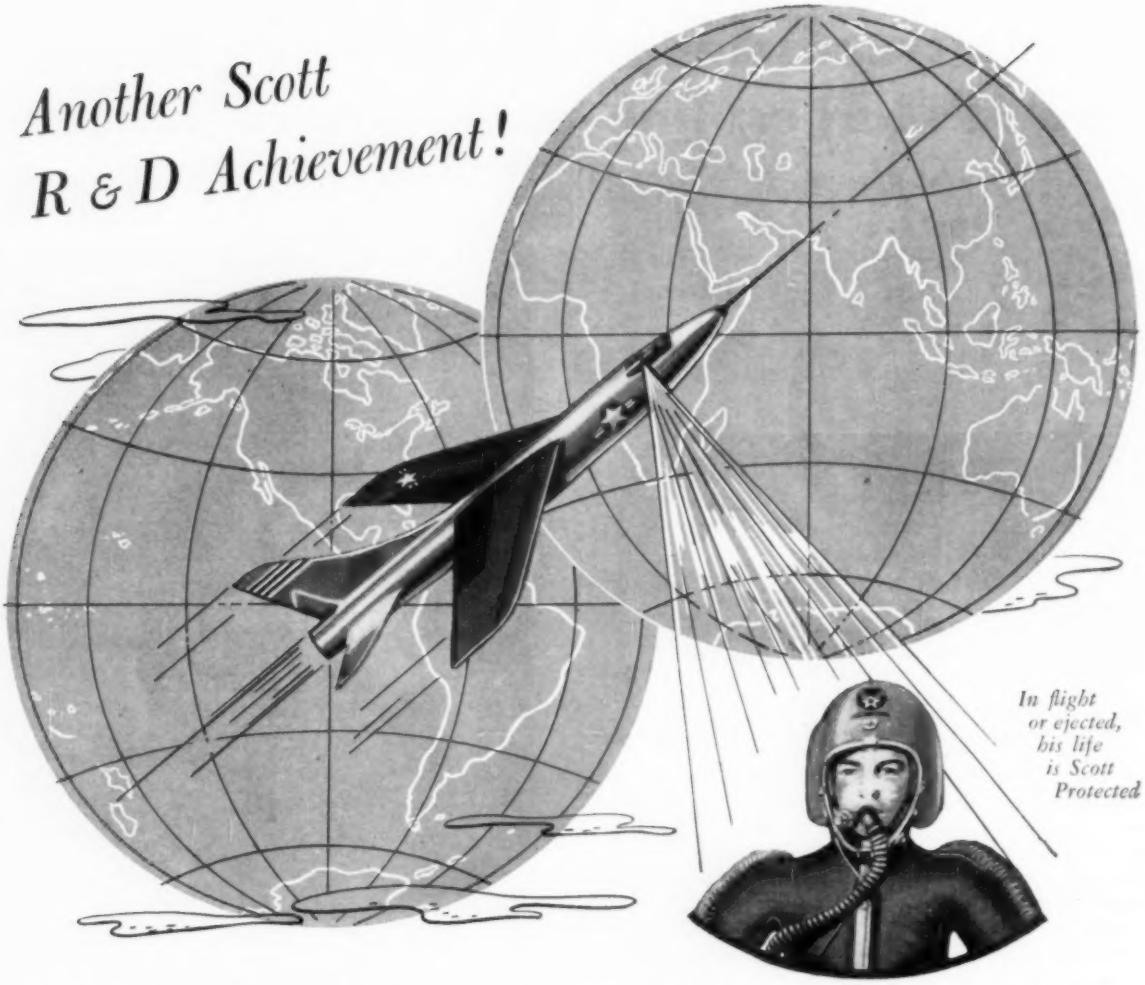


How the **WRIGHT HOIST DIVISION** of American Chain and Cable Co. mounts Timken tapered roller bearings on the trolley wheels of its cranes to take the loads, keep them on the go.

TIMKEN TAPERED ROLLER BEARINGS ROLL THE LOAD

TRADE-MARK REG. U. S. PAT. OFF.

Another Scott R & D Achievement!



In flight or ejected, his life is Scott Protected

A Completely Integrated System of High Altitude Breathing & Survival Protection

For a quarter of a century the practical results of Scott Research and Development have enabled Scott Aviation to maintain its leadership in aviation breathing equipment. Now Scott announces production of a completely integrated system of high altitude breathing and survival protection, so necessary for the pilot in today's high performance, supersonic military jet aircraft.

Whether in flight or ejected, breathing protection is automatically maintained. In an emergency, aircraft main supply lines are disconnected automatically and the self-contained unit is actuated without human effort. Simplification is the keynote of this new Scott System. The usual maze of hoses and wires has been eliminated . . . with considerable weight saving.

For the shape of things to come, keep an eye on Scott R & D!

NOW READY FOR PRODUCTION

Scott has ever been cognizant of the importance of Applied Human Engineering. This new high altitude survival protection system is an example. It is past the experimental stage and is ready for production. Further information available to persons active in this field. Write for it today!

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The tools and equipment used at Dallas Airmotive are the best to be found. Not only are these tools the finest in quality but are in a quantity not to be found outside the manufacturer's plant.

Dallas Airmotive's technicians are outstanding specialists in the field of airplane engine overhaul.

Years of experience and the record of 8,000 engine overhauls results in Time-Tested Reliability.

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How come nobody picks on the hummingbird? He's tiny, he's inoffensive, and he spends his time tranquilly fooling around among the flowers while bigger birds battle noisily for survival. By rights he ought to be extinct, but he's left alone because he packs a fearsome weapon and knows how to use it. With his rapier-like beak and darting speed, he is feared by would-be intruders as a veritable D'Artagnan of the honeysuckle. Until the happy day comes when lions will lie by lambs and predators are out of politics, the cause of peace is best served by those equipped to defend it.

➤ ➤ We at REPUBLIC take pride in the long roster of accomplishment which Thunder-craft have written . . . such as the Thunderbolt, Thunderjet, Thunderstreak and Thunderflash . . . the potential of the new F 103 and F 105 emphasizes again the touch of engineering genius and production skills which have long been the pride mark of this famed fighter family.

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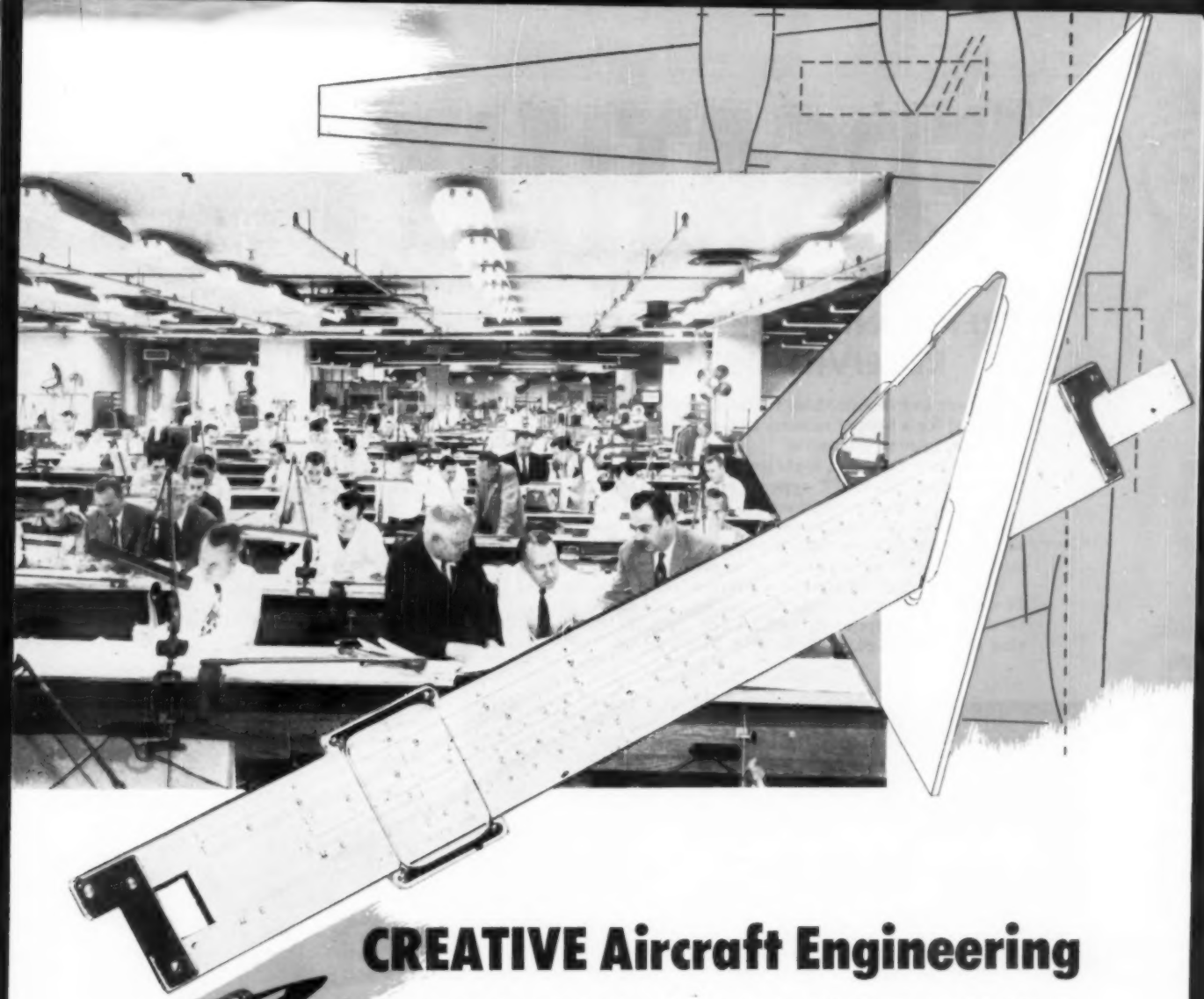

CREATIVE Aircraft Engineering

Hayes engineering is the backbone, the nerve center, of the Hayes aircraft facility. The Hayes engineering staff represents hundreds of years of cumulative experience in the analysis, design, and development of aircraft structures, and aerodynamics; and mechanical, electrical, electronic, hydraulic and other aircraft components and operating systems. Successful solution of tough engineering problems under drastic delivery deadlines has proved the ability of Hayes engineers to meet new and difficult challenges in design.

Creative engineering plays an indispensable role at Hayes in aircraft developments that range from wiring circuits to complete conversion of multi-engine aircraft for a new jet-age mission. Critical projects in guided missiles, integrated weapons systems, associated ground-handling equipment — and other allied projects — are currently under way in Hayes engineering and production departments.

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With over 6,000 employees, Hayes is a competitive industrial facility for modification and maintenance of aircraft, including guided missile work and engineering design of all types. Opportunities are open for experienced aircraft design engineers, and graduate students in engineering. Write Personnel Department.

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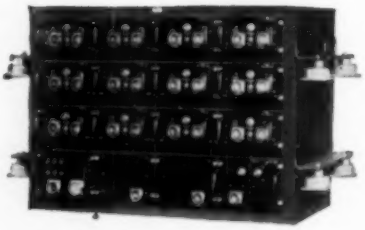
VERSATILITY

RREP MINIATURE TELEMETRIC RECEIVING SYSTEMS

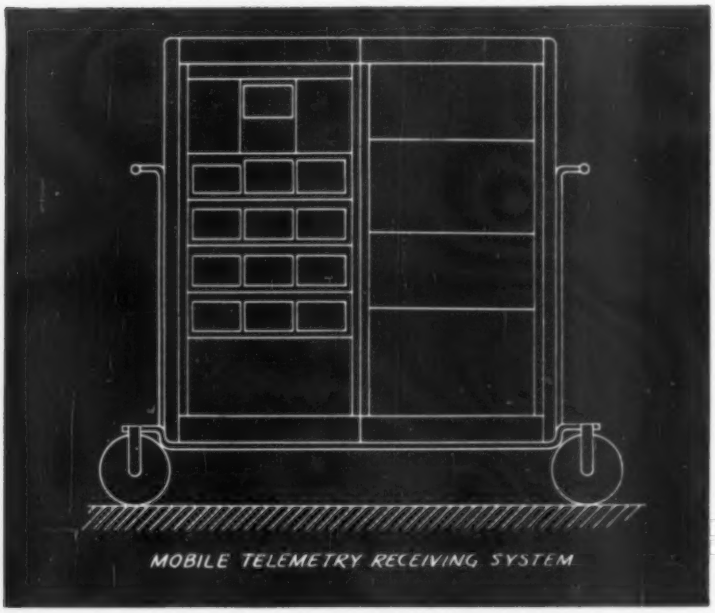
Miniature and mobile, here's a telemetric receiving system designed for a host of military and civilian applications . . . airborne, ground or marine!

For missile checkout, flight tracking experimental aircraft and missiles, the RREP systems are highly effective, even under the most severe field service conditions. They operate ideally with tape recording, oscillographic, photographic and similar types of recording equipment . . . and this rugged equipment can be installed in jeeps, autos and trailers.

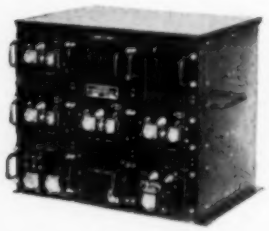
Design-wise, these systems achieve substantial reductions in weight, size and power consumption—yet a high degree of accuracy, exceptional stability and simplicity of operation are maintained.



RREP 12-Channel Receiver. Modular construction permits wide flexibility of arrangement and actual form factor of receiving equipment. Packages or combinations in any number from one to eighteen units can be arranged in various mounting styles.



MOBILE TELEMETRY RECEIVING SYSTEM



RREP Type 1701A 4-Channel Receiver. Use as flexibly as 12-channel unit—split up in combinations to suit your particular receiving requirements. Ideal for flight line checkout.

◀ Telemetering on wheels! New portable test cart enables users to perform wide variety of telemetering functions in previously inaccessible locations, with greater efficiency and accuracy than ever before.

Technical bulletins on miniature receiving systems and other RREP products available on request.

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Dependable performance is a quarter-century tradition at Motorola—the world's largest exclusive manufacturer of electronic equipment. Under subcontract to Convair, Motorola *engineered for reliability,* and is now producing the guidance equipment for the Navy's new, all-weather anti-aircraft missile, the "Terrier".

Positions open to qualified Engineers and Physicists

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COMMUNICATIONS & ELECTRONICS DIVISION
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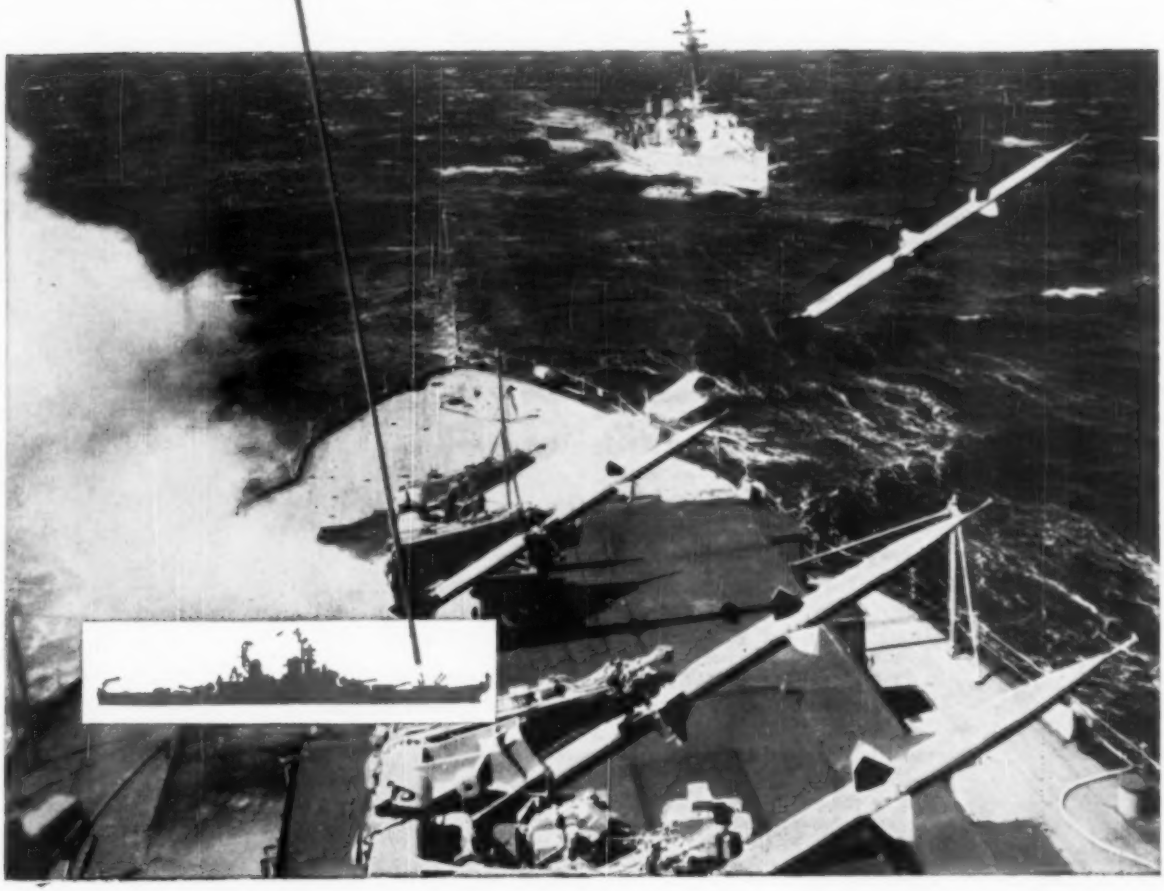
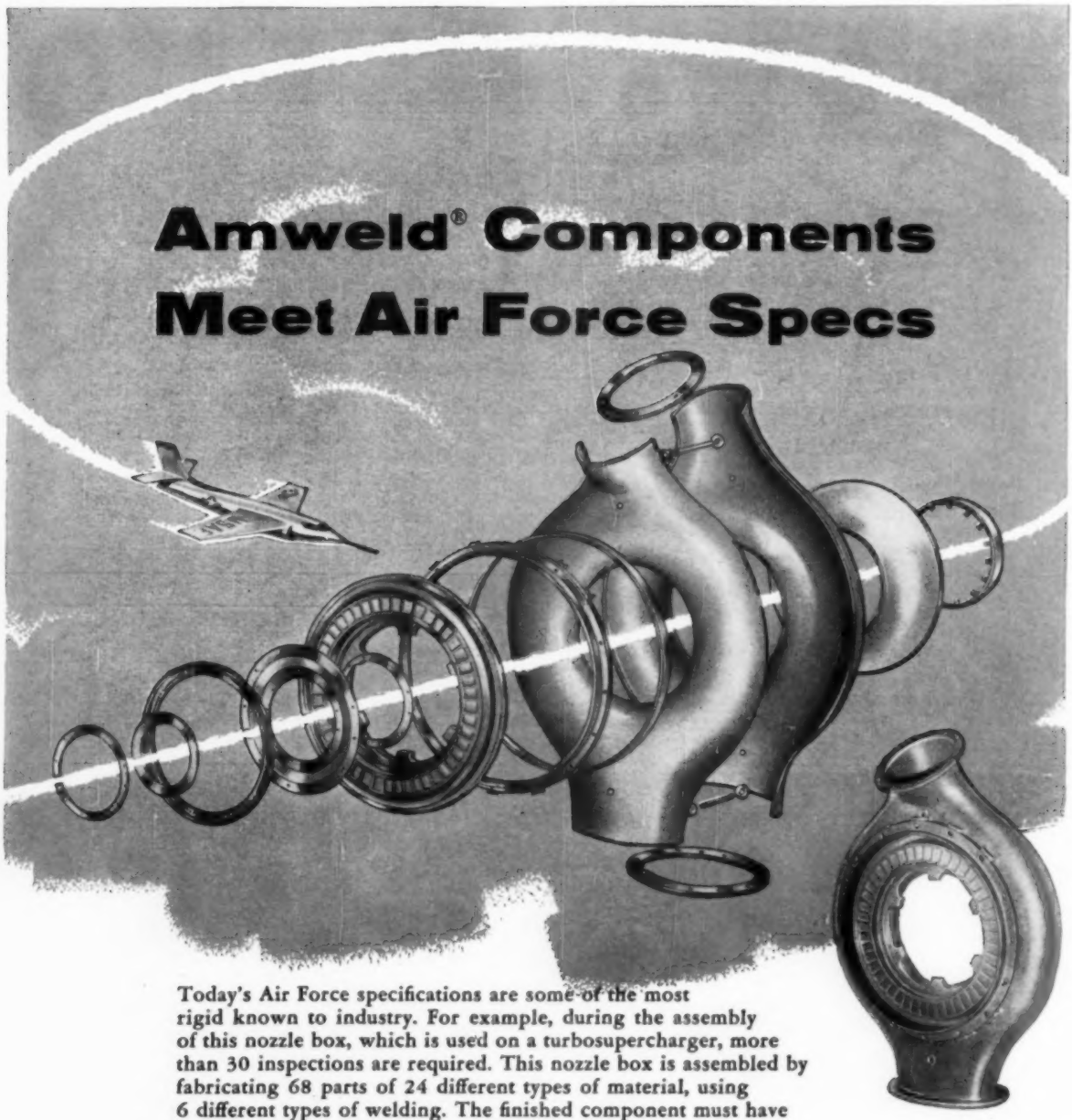


Amweld® Components Meet Air Force Specs



Today's Air Force specifications are some of the most rigid known to industry. For example, during the assembly of this nozzle box, which is used on a turbosupercharger, more than 30 inspections are required. This nozzle box is assembled by fabricating 68 parts of 24 different types of material, using 6 different types of welding. The finished component must have the same tensile strength and original characteristics as the parent metal.

Amweld, with its special ability to form, weld, size and machine rings, circular weldments and components, is geared to the manufacture of such complex parts.

Do you have a component assembly problem? If so, contact the Industrial Products Division of The American Welding & Manufacturing Co. today! They will be pleased to help you.

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AMERICAN WELDING

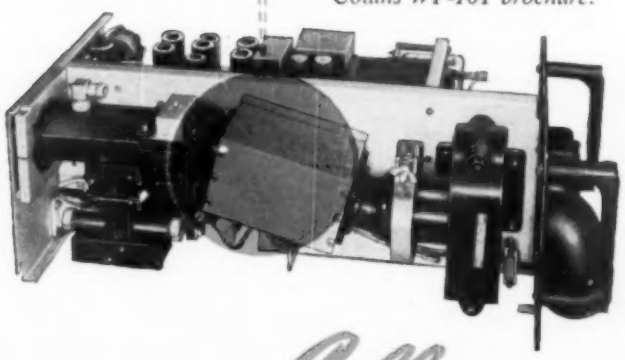
ONE *of the*
advanced engineering features
assuring high reliability in
COLLINS WEATHER RADAR

This component in the RT unit of Collins WP-101 Airborne Weather Radar System is a *load* isolator. Its function is to allow the magnetron to operate into transmission lines having less critical characteristics which otherwise must be corrected by complicated line tuning.

The load isolator also protects the magnetron from high VSWR conditions caused by accidental damage to the wave-guide. Generally this damage is detected only by a series of successive magnetron failures — an expensive procedure in both time and money. It all adds up to an extra measure of reliability engineered into Collins Weather Radar System

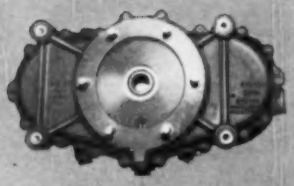
There are many other advanced engineering features in the WP-101 system, including: simplified circuitry; printed wiring, which connects *and* supports components, adding strength without weight penalty; reduced tube count; modular construction throughout, for maximum serviceability.

For complete information, write for Collins WP-101 brochure.



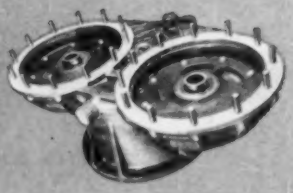
Collins CREATIVE LEADERSHIP IN AVIATION ELECTRONICS

Collins Radio Company, CEDAR RAPIDS, IOWA; 261 Madison Avenue, NEW YORK 16, NEW YORK; 1200 18th Street N.W., WASHINGTON, D.C.; 1930 Hi-Line Drive, DALLAS 2, TEXAS; 2700 W. Olive Avenue, BURBANK, CALIFORNIA; 1318 4th Avenue, SEATTLE, WASHINGTON; 4471 N.W. 36th Street, MIAMI SPRINGS, FLORIDA; COLLINS RADIO COMPANY OF CANADA, LTD., 11 Bermondsey Road, Toronto 16, Ontario; COLLINS RADIO COMPANY OF ENGLAND, LTD., Sunflex Works, Colham Mill Road, West Drayton, Middlesex, England



Dual accessory drive unit, rated at 40 HP at constant 3200 RPM, weight 16½ lbs.

For use on VTO aircraft, accessory drive weighs only 14 lbs. Operates on input of 35 HP at 5500 RPM. Two power take-offs operate at 7810 and 4350 RPM.



Accessory drive designed for North American, weighs 38 lbs. 70 HP input at 6000 RPM. Two power takeoffs at 6CC0 RPM each.

Designed and manufactured for Boeing KC97. Approximate weight 10 lbs. Six horsepower (continuous duty) input at 6000 RPM operating one power take-off drive at 2620 RPM.

Combination engine starter and accessory drive for Chance-Vought F8U-1 Navy Fighter. Ten horsepower (continuous duty) driving hydraulic pump at 4200 RPM. 55 HP intermittent service. Continuous input speed 7000 RPM. Weight 27 lbs.

Note to aircraft designers...

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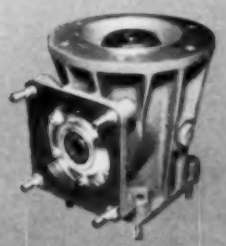
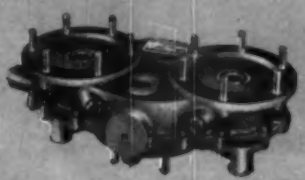


Dual hydraulic pump adaptor, rated at 35.7 HP at 6000 RPM, weight 26 lbs.

For Convair T-29. Approximate weight 13½ lbs. Input horsepower 103. Input speed 4000 RPM. Two power take-off drives operate at 9000 RPM each.



For use on fighter aircraft, 75 HP input at 7000 RPM. Two power take-offs, 35 HP at 3630 RPM and 37 HP at 3820 RPM. One pad for starting J-75 engine. Capable of 6600 inch-lbs. starting torque.

JUNE 18, 1956

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COVER: A new phase in the Cessna T-37A twin-jet program began June 8 when the first of four production planes left the company's Prospect, Kan. plant for Air Research & Development Command's Air Force Flight Test Center, Edwards AFB, Calif. At the conclusion of ARDC tests, production T-37As will be assigned to USAF's Air Training Command to develop procedures and documentation prior to delivery to Air Force contract schools. Other new T-37A pictures are on p. 119.

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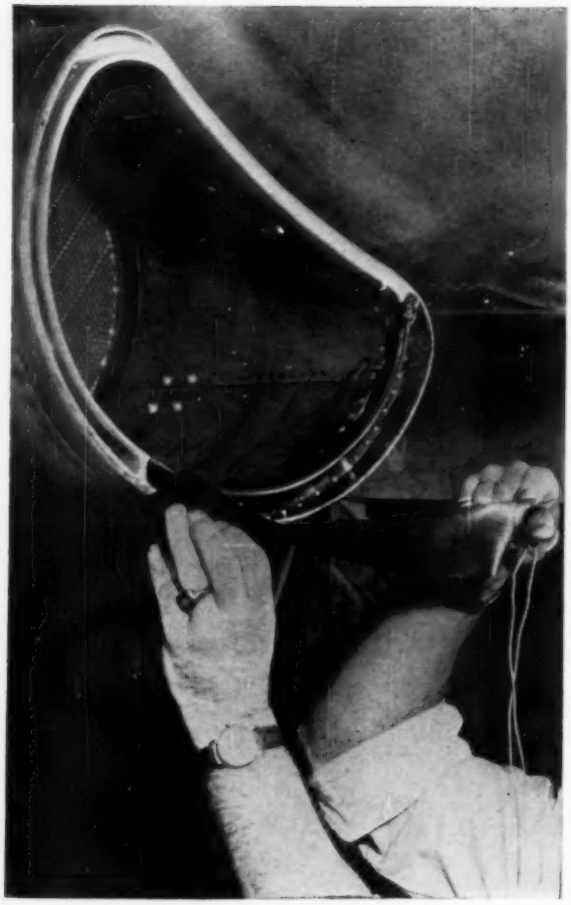

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EDITORIAL

Where Do We Stand?

Climbing out of Washington on a sunny morning aboard one of American Airlines commuter-loaded Convairs bound for New York, we relaxed into reflection on the great debate over the future of American airpower being waged under the Capitol dome that slid by underneath. The scene looking out of that Convair window provided a panorama of the problem. Below, in the shimmering heat haze, busy cities bustled, and the checkerboard of fertile farm fields and deep green woods lay in the midst of the greatest prosperity this country has even known. More than 30,000 ft. above the cities and farms, pluming white contrails were weaving a pattern of attack and interception across the sky as B-47s of the Strategic Air Command and F-86Ds of the Air Defense Command practiced their trade.

The millions working and playing below had little concept of what the few were doing above. This is one of the major problems in the current airpower debate—so few of this country's millions who are dependent upon a superior shield of airpower for their future realize how this shield must be forged in the factories, laboratories and test centers on the ground and then wielded by relatively few skilled airmen in a deadly game, most of which is invisible even to the participants.

It is this great disparity between public understanding and professional performance that is at the root of many of our airpower problems and is the main reason for the reluctance to solve them. Another major factor in preserving this disparity is the lack of frank, honest and intelligent leadership on the airpower issues by the civilian heads of our government.

In the wide discrepancy of statements made by critics and defenders of the current national airpower policy, it must appear to the millions on the ground that somebody is failing to tell the truth. Yet analysis of the main issues in this debate indicate that this is not accurate. Nobody has deliberately falsified an issue, but many are deliberately telling only that part of the truth which suits their purpose.

Lets look at some of these opposing viewpoints.

President Eisenhower in his annual budget message to Congress said his Administration was spending the largest sum ever expended in peacetime on airpower and building the most powerful military air forces in this country's history. This is perfectly true.

Critics of the Administration's airpower program say it is grossly inadequate to meet the challenge of our future military problems, and that we are in grave danger of losing the air superiority that has been a keystone of our national policy. This is also true.

The point is that the President is comparing our airpower to our past strength while his critics are comparing it to the fast-growing Russian air force.

President Eisenhower tells newsmen at his press conference that we must not consider just the Air Force in measuring U.S. airpower but also Naval aviation, the Marine air wings and Army aviation. This is true.

His critics charge that the failure to enlarge and improve the Strategic Air Command is the critical weakness in the Administration's airpower program. Gen. Nathan F. Twining, USAF Chief of Staff, has testified before a Senate committee that the Navy's contribution to long-range, air-atomic striking power is "small." Adm. Arleigh Burke, Chief of Naval Operations, supported General Twining's position by telling a Pentagon press conference that the Navy and Naval aviation had the primary mission of maintaining control of the sea, and that they must be deployed against targets which threaten this control. All of these statements are true. Marine, Army and Naval aviation and even the airlines do add to the total strength of U.S. airpower but they do not add an iota to the ability of U.S. airpower to deliver atomic and hydrogen weapons directly to the enemy's heartland.

Defense Secretary Charles E. Wilson makes speeches saying we have superior airpower today, and that it is impossible to tell what the future may bring. This is true so far as it goes, but it is possible to tell what the future of airpower will be by the amount of research and development effort that is being made today.

Mr. Wilson's critics maintain that the airpower issue does not involve any question of U.S. airpower's current superiority but, rather, the relative rates of progress of U.S. and Russian airpower development. They maintain that the real issue is this: Will we maintain wide and significant superiority for the foreseeable future? This is also true. It is useless to measure airpower in being at any given moment as a guide to future policy. It takes time—too much time many people charge—to develop airpower in being. The key to the quantity and quality of U.S. airpower of the future lies in the appropriations, research effort, development pace and production effort being made now.

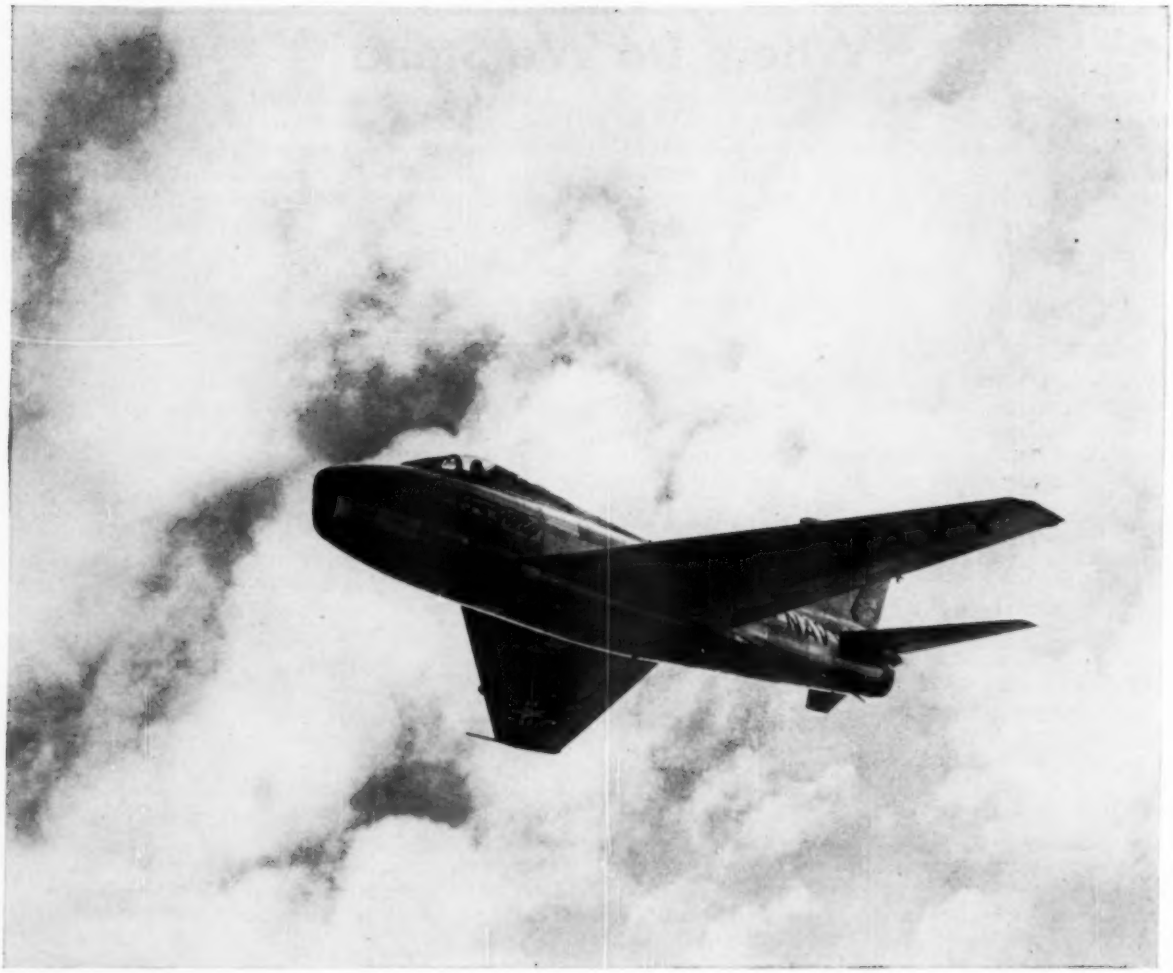
President Eisenhower states at a press conference that this country is ahead in some phases of missile development, and Russia is ahead in others. This is true as far as it goes.

His critics amplify the picture, pointing out that the U.S. is ahead in short-range defensive missiles while Russia is ahead in the long-range ballistic missiles that promise the next great technical breakthrough in weapons development. This is also true. USAF Secretary Quarles warns that the intercontinental ballistic missile is not an ultimate weapon and that manned bombers will play an important role for many years to come. This is perfectly true. There never was, and never will be, an ultimate weapon, and it would be folly to abandon a proven type of weapon before a new type has passed from the experimental stage.

Mr. Quarles critics point out that the nation that first achieves a workable ICBM will gain a tremendous advantage in its international position, and that the U.S. B-52 bomber program is proceeding at a rate already inferior to Russian heavy bomber production. Both of these statements are also true.

It was to provide the missing links between this welter of apparently conflicting statements and to fill in the factual record of where we stand today in relation to Soviet airpower, and where we will stand *vis-a-vis* the Russians in the future as a result of current policies, that the Senate subcommittee headed by Stuart Symington (D.-Mo.) was given congressional and public approval. To date, it is doing an excellent job of providing the American people with the first complete and accurate record of where our airpower stands today and where it is going in the future.

—Robert Hotz



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North American's FJ-4, latest of the Fury series of Navy jets, flies with vital parts made of titanium—from nose to tail. For this fastest of the Furies has a heritage of titanium.

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WHO'S WHERE

In the Front Office

Richard L. Fitzpatrick, director, American Airlines, succeeding **M. D. Miller** retired. Also **W. Baddock Hickman**, economic research director.

R. J. Lutz has joined the staff of **R. C. Sebold**, vice president-engineering, Convair Division of General Dynamics Corp., San Diego, Calif.

Dr. Rodolfo M. Soria, vice president-engineering, Amphenol Electronics Corp. (formerly American Phenolic Corp.), Chicago, Ill.

Dr. Howard O. McMahon, science director, has been elected vice president, Arthur D. Little, Inc., Cambridge, Mass.

H. J. "Bill" Mock, president-general manager; **Mihai "Mike" Patrichi** (chief engineer), board chairman; and **Frank Ramsauer**, vice president-sales, Networks Electronic Corp., Van Nuys, Calif.

James L. Anast, systems planning advisor to **Edward P. Curtis**, White House Aviation Advisor.

Honors and Elections

Gen. Joseph T. McNarney, USAF (Ret.), president of Convair Division of General Dynamics Corp, will be named "National Management Man of the Year" by the National Management Association because of "his devotion to and promotion of the high management principles and objectives of the NMA." (NMA 33rd national conference, Sept. 28-29, St. Louis, Mo.)

J. H. "Dutch" Kindelberger, board chairman, North American Aviation, Inc., received an honorary degree of doctor of engineering from Carnegie Institute of Technology.

Gen. Curtis E. LeMay, commander-in-chief, Strategic Air Command, USAF, received an honorary doctor of laws degree at the annual commencement exercises of West Virginia University. **Nathan I. Hall**, vice-president and director, weapon systems development laboratories, Hughes Aircraft Co., and **Earle S. Thompson**, president, West Penn Electric Co., received honorary doctor of Science degrees.

Donald W. Douglas, president, Douglas Aircraft Co., was chosen to receive the 1956 Elmer A. Sperry Award. He was honored by The American Society of Mechanical Engineers, American Institute of Electrical Engineers, Society of Automotive Engineers and The Society of Naval Architects and Marine Engineers for advancing the art of transportation through development and production of the "DC" series of airplanes.

Changes

Morris Ackerman, chief simulator engineer (flight training simulator section), and **Charles B. Smith**, chief project engineer, ERCO Division, ACF Industries, Inc., Riverdale, Md.

Vernon D. Hauck, assistant general manager, Friez Division, Bendix Aviation Corp., Baltimore, Md.

(Continued on p. 101)

INDUSTRY OBSERVER

► Curtiss-Wright is pushing a proposal at Department of Defense level to re-equip all USAF Boeing B-47 Stratojet bombers with its J65 Sapphire turbojets, replacing the General Electric J47 turbojets now in service. USAF has approximately 2,000 B-47s, and the Wright proposal, if accepted, would develop a market for close to 20,000 engines.

► Reaction Motors Inc. has a major subcontract from Aerojet for the development of combustion chambers for high-powered rocket engines for use in Martin's Titan intercontinental ballistic missile.

► Hughes Aircraft has received a $38 million USAF contract for the production of fire-control systems for Convair's F-102 interceptor.

► Accuracy of Boeing's Bomarc anti-aircraft missile is better than expected. Slant range of the missile, now being test fired about every two weeks, is reported to be approximately 200 miles and may be approaching 300. The production program has been drawn up, but the Pentagon is withholding its announcement. The missile's pilot production line at Seattle may be transformed into a main production source, although USAF has specified Boeing's Wichita plant production.

► Hughes Aircraft is developing a family of Falcon missiles. Guidance changes are one aspect of this development. Revisions in the system are aimed at keeping ahead of the electronic counter measures a potential enemy might develop.

► New guidance equipment still under development is expected to substantially increase the range of the Martin Matador. Range is now limited by current guidance techniques rather than by fuel capacity.

► Ramo-Wooldridge has come up with the only solution proposed thus far for the airborne-collision warning device being sought by the Air Transport Association and has asked the airlines to underwrite its development at an estimated cost of more than $500,000. ATA is reluctant to set a precedent by financing airline avionic equipment, but lack of a competitive idea may force acceptance. The proposed device reportedly employs Doppler techniques similar to those conceived by Cornell Aeronautical Laboratory.

► Cost of the Pratt & Whitney J57 engines used on the Boeing B-52 is $185,000 each. Total cost of a single B-52 is now down to $10 million; first production aircraft delivered to the Strategic Air Command were billed at approximately $12 million each.

► Lockheed's F-104 Starfighter is not now equipped with air-to-air refueling capability, although plans have been drawn up for its inclusion if the Air Force wants it. Presumably, a Starfighter order by the Tactical Air Command would specify probe-and-drogue refueling.

► McDonnell has small Navy order for F4H twin-engine, all-weather fighter designed for Mach 2 speeds. First rollout of the aircraft, to be equipped with General Electric J79 engines, is scheduled for next May.

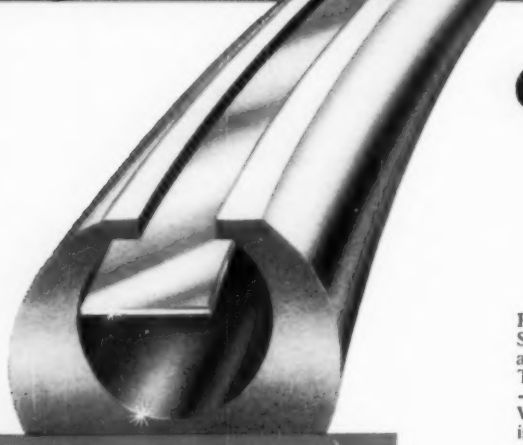
► Current estimates of aircraft range increases available with some of the "exotic" fuels are approximately 40% above JP-4 ranges.

► A special NATO project is evaluating the relative merits of U. S. and European metals in an effort to help offshore manufacturers qualify their products under USAF specifications.

► First of six Folland Gnats being built by the Ministry of Supply made its initial flight on May 26. Two days later it was flown to Boscombe Down for ground-firing tests. Air-firing tests will begin in the near future.

► Navy expects all angle-deck carriers to be equipped with the British-developed mirror-landing system by the end of Fiscal 1957. Navy says the system, which substitutes blob of light in center of the mirror for the landing signal officer, is now "pretty well accepted as an operational device."

ACTUATORS with a difference



Can you use

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- *Travel equal to total length*

Free piston pneumatic actuators – dubbed "pogo sticks" – are being produced by Stratos. Based on a unique operating principle, they have no piston rod. Thousands are in use for ejection of stores from aircraft.
These patented ejectors are capable of hurling delicate stores – such as sonobuoys – clear of high-speed airplanes... without endangering fragile components.
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- Stroke nearly equal to total package length
- Piston travel through an arc
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- High temperature suitability
- No limit on length
- Long life – no seals or glands to wear
- Lightweight
- Wide pressure range – 20 to 1500 psig
- Tube can carry structural load or be part of structure

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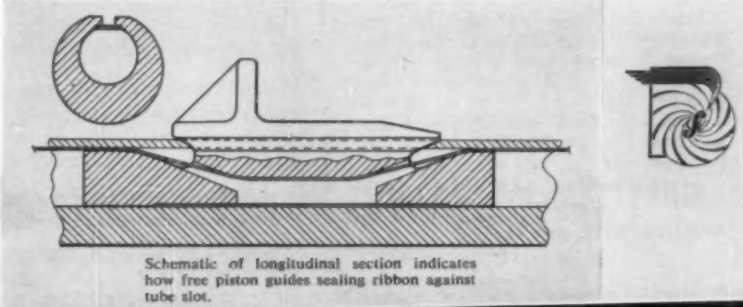


Schematic of longitudinal section indicates how free piston guides sealing ribbon against tube slot.

WASHINGTON ROUNDUP

Russian Missile Defenses

Positive statements that the U. S. Air Force has photographs of Russian anti-aircraft guided missile installations in the Moscow area were made by Gen. Earle Partridge, commander of the Continental Air Defense Command, and Sen. Stuart Symington (D.-Mo.), chairman of the Senate subcommittee investigating U. S. airpower. Testimony by General Partridge before the subcommittee said the Russian missile installations around Moscow were for missiles similar to the Army's Nike and the Navy's Talos.

Will Quarles Succeed Wilson?

You can get no bets in the Pentagon that Defense Secretary Charles E. Wilson will remain in his present post long after the November presidential election regardless of the results. Best bet to succeed him, if the Republicans elect a president in November, is Donald Quarles, now secretary to the Air Force. Quarles' efforts to tone down USAF criticism of the current airpower program are winning him strong support in Republican circles but are opening a rift between him and the military leaders of the Air Force.

More Regular Officers

The Administration has introduced a bill before Congress that would permit the armed services to increase their regular officer strength to 50% of the total number of officers on active duty. At present, 25.6% of the Army officers and 17% of the Air Force officers are regulars. Defense Secretary Wilson, in testimony supporting the bill, told a House Armed Services Subcommittee: "Under conditions existing today, our nucleus of regular officers is too small. Only one-fourth—are regulars. The remaining . . . are reservists, serving various tenures without the security and recognition of a permanent career. Too many of them are leaving at the first opportunity." Wilson said enactment of the bill would permit "immediate" transfer of "substantial number" of reserve officers into the regular service. Air Force has said a better regular-reserve ratio would help in retaining some of the pilots who leave the service to go into civilian flying jobs where pay, fringe benefits and security are better. A good many want to transfer to regulars, leave the service when they find out they cannot (AW Jan. 16, p. 122).

Furnas Victory Assured

"Clean victory" of Dr. Clifford C. Furnas, Assistant Secretary of Defense for Research & Development, in his fight to keep his mission intact now appears assured. In a new memorandum circulated in the Pentagon, Defense Secretary Wilson "confirms and clarifies" Furnas' assignment as well as that of Frank D. Newbury, Assistant Secretary of Defense for Applications Engineering. Practical effect: their areas of responsibility revert to what they were before Feb. 21, when Newbury won the right to review and approve development projects (AW Mar. 5, p. 26). Both Furnas, who threatened to quit, and Newbury have signed a paper stating they recognize the delineation of their jobs. Wilson says Furnas is responsible for research funded by R & D appropriations and Newbury for later stages of development projects paid for out of procurement funds. In between, there are the earlier stages of weapons development, funded by R & D money but involving both research and engineering questions. In this area, both Furnas and Newbury are responsible for program review and approval. They will be helped by co-ordinating committees.

CAB Threatens No-Show Probe

The threat of a Civil Aeronautics Board investigation of the no-show problem hangs over the Air Traffic Conference when it meets in Washington this week. The ATC meeting has been called to find a solution to the no-show problem, and the CAB has told the airline group that this is its last chance. CAB Chairman James R. Durfee said, however, that the Board thinks "the industry can and should settle this problem by itself, rather than force the Board to take steps seeking a solution." He urged that a decision be reached "without any further postponement."

Air Postage Increase

Postmaster General Arthur Summerfield's plan to boost the air mail postage rate from six to seven cents has already run into strong opposition in the House. Although it was approved by a majority of the 25-member Post Office Committee, eight Democratic members have filed a protesting minority report. They state that the increase "is not supported by the cost ascertainment report of the Post Office Department" which shows that for Fiscal 1955 there was an excess of revenues over expenditures for domestic air mail operations of $20.3 million.

Sen. Olin Johnston (D.-S.C.), chairman of Senate Post Office Committee, also is opposed to the increase.

USAF Chaff

Most embarrassing word for USAF requirements officials these days: Chaff. Recent House budget hearings uncovered evidence that the Air Force originally sought $31 million worth of aluminum strips, known as Chaff, and used as a radar counter-measure, when Fiscal 1956 money was being considered. On first review, this was cut to $16 million. Staff analysis resulted in a recommendation from the office of the Secretary of Defense that it be slashed to $6 million. Then training requirements were studied with final agreement that no funds will be spent for Chaff in Fiscal 1956 or 1957. Not mentioned in the testimony was the factor of scientific progress and growing importance of electronic countermeasures to baffle enemy search radar.

Defense Security Quiz

Secretary of Defense Charles E. Wilson and other Pentagon officials will be called before the House Information Subcommittee, headed by Rep. John E. Moss (D.-Calif.), beginning June 25 for questioning on information and security policies. One of the areas to be explored is the withholding of information that is in the "unclassified but unreleasable" category. Defense officials will appear first, followed by representatives of each of the services. **—Washington staff**

LeMay Asks $3.8 Billion Budget Hike

Strategic air chief requests $1.8 billion for B-52, KC-135 procurement in Fiscal 1957; $1.8 for bases.

By Katherine Johnsen

Washington—A key Senate subcommittee is considering boosting the USAF's Fiscal 1957 budget by $1.8 billion for the procurement of B-52 bombers and the KC-135 jet tankers needed to refuel them.

This amount would be in addition to the supplemental $248.5 million requested by President Eisenhower to step up the B-52 program on April 9, eve of an investigation into the U.S. airpower program by a Senate Armed Services Subcommittee headed by Sen. Stuart Symington (D.-Mo.).

The new move to further augment the B-52 and KC-135 programs was touched off last week in executive testimony by Gen. Curtis LeMay, commander of Strategic Air Command, before the Senate Military Appropriations Subcommittee headed by Sen. Dennis Chavez (D.-N.M.). Gen. LeMay told the subcommittee that an additional $3.8 billion over and above the programmed USAF program for Fiscal 1957 and later years would be required annually to keep abreast of the Soviet Union in long-range bombing capability.

Where Funds Would Go

The $3.8 billion would bring SAC's total allocation for Fiscal 1957 to over $8 billion. This level, Gen. LeMay told the subcommittee, should be sustained over the next four years.

Of this total, LeMay earmarked for Fiscal 1957:

- **$1.8 billion for aircraft** and related procurement.
- **$1.8 billion for bases.**
- **$100 million for procurement** other than aircraft (presumably a large portion of this will go to electronics counter measures).

The remainder would go towards personnel and other items.

In earlier testimony before the Symington Subcommittee, Gen. LeMay reported that, under the Administration program, strategic air superiority would pass from the U. S. to Russia in the 1958-60 period (AW May 7, p. 28).

In the testimony, however, LeMay named technical personnel and bases as SAC's two major deficiencies. The personnel problem, service-wide with USAF, is now being studied by Secretary of the Air Force Donald Quarles.

KC-135 Greatest Need

LeMay recommended an even greater increase in KC-135 production than in B-52 production.

The Senate Military Appropriations Subcommittee plans to vote on the Fiscal 1957 defense budget sometime this week. It probably will come up for floor debate either this week or next.

Other developments in the airpower picture last week included:

- **The Senate Appropriations** Subcommittee appeared ready to write a stipulation into the budget barring the use of production funds for either the Talos or Nike B until the precise roles of the two competing missiles are determined. Sen. John Stennis (D.-Miss.), a member of the subcommittee, has insisted upon a competitive testing of the two missiles to determine their relative capabilities.
- **Sen. Symington** protested an Administration plan to equip units of the Tactical Air Command with "obsolete" B-29 and B-50 tankers. Symington also pointed out that, because of the limited number of tankers at the present time, it would be virtually impossible to fly TAC units overseas for action on short notice.
- **Lt. Gen. C. S. Irvine,** deputy chief of staff for materiel, testified that additional USAF airlift would more than pay for itself through savings in improved logistic support, which, in turn, would reduce procurement requirements.
- **Lt. Gen. Emmett O'Donnell,** deputy chief of staff for personnel, reported that USAF's personnel strength—military and civilian—has dropped from 1,351,161 in Fiscal 1953 to 1,349,812. It is scheduled to increase to 1,369,404 during Fiscal 1957.
- **Maj. Gen. Lee B. Washbourne,** assistant chief of staff for installations, said USAF's base program in Fiscal 1955 and 1956 was $835 million short of requirements.

Irvine, O'Donnell and Washbourne testified before the Symington Subcommittee.

'Penny Wise'

Gen. Irvine told the subcommittee that the USAF is being "penny wise" by economizing on airlift and on installations for field repair of aircraft and engines. He added:

"By accomplishing field maintenance on our J47 engines, we have reduced spare engine requirements so we have been able actually to cancel thousands of engines. We have been able to get the flying time between depot overhauls up from 50 hours to where we are now passing 1,500."

With airlift, he noted, "You can save more money in the spares you don't buy than the logistic airplanes would cost, and you can do a better job in time of peace and a lot better job in case of emergency."

Sen. Symington observed that "the responsibility for airlift for the Army is given to the Air Force and, therefore, I am glad to hear this additional reason for more airlift."

Irvine reported that the only tankers programmed for TAC through Fiscal 1959 are B-29s, B-50s and KC-97s.

R & D Experts to Moscow With Twining

Washington—Three top Air Force research-and-development experts will accompany Gen. Nathan F. Twining, USAF Chief of Staff, on his trip to Moscow to attend the June 24 Russian air show. They are:

Lt. Gen. Donald L. Putt, deputy chief of staff for development.

Lt. Gen. Thomas S. Power, commander of the Air Research & Development Command.

Maj. Gen. Al Boyd, deputy commander of ARDC for weapons systems.

Other top USAF generals in the party will be Lt. Gen. Frank F. Everest, deputy chief of staff for operations; Lt. Gen. Clarence S. Irvine, deputy chief of staff for materiel, and Brig. Gen. William H. Blanchard, deputy director of operations, Strategic Air Command.

Also accompanying Gen. Twining will be two of his Pentagon aides, Col. James C. Sherill and Col. William H. McVey, and the new U. S. air attache designate to Moscow, Col. Thomas W. Wolfe.

The party will travel to Russia in a Douglas C-118 (DC-6A) transport, scheduled to arrive in Moscow on June 23. They will inspect some USAF units in Europe en route to and from the Russian capital.

Sen. Symington then objected that these are "obsolete, low-altitude, non-jet tankers" and asked: "Wouldn't you say that the life of a fighter pilot in TAC is worth as much as the life of a fighter pilot in SAC?"

Why No Tankers

Irvine replied that "this again is priority of programs. Let's face the fact in the Air Force that the missile program and the long-range bomber program are considered of first priority."

He said the USAF plans in "several years" to attain a peak production of 20 KC-135 tankers at the Boeing Airplane Co. in Seattle. He said that the plant could "easily" have a peak of 35 a month and that the Boeing's Seattle and Wichita plants could produce 45 B-52s monthly, as compared with the programmed peak production of 20.

Under the present program, he said, the U.S. eventually will have approximately 600 B-52s and 400 KC-135s. Gen. LeMay has called for a one-to-one ratio.

Should the KC-135 program be increased, Irvine indicated that the USAF would "spread the work around."

He commented that "we have other plants like Tulsa, Fort Worth and Marietta where we might decide to put some of the production for dispersion purposes and also to get competition and possibly get the price down."

The industrial production capacity for USAF, Gen. Irvine reported, is "from two to four times the levels we are now using. Once developed, new weapons systems can be produced at whatever rates the programs call for."

Weyland Asks for KC-135

Washington—Gen. Otto P. Weyland, head of the Tactical Air Command, called for a fleet of Boeing KC-135 jet tankers to improve TAC's "marginal capability" in airlift during testimony before the Senate Airpower Investigating Subcommittee.

In testimony released last week, Gen. Weyland said his command's airlift capability now "meets our actual emergency war plan requirements, but as we are going more and more into moving our units overseas, it is becoming increasingly marginal."

Tankers programmed for TAC over the next three years are obsolescent B-29s and B-50s. Gen. Weyland said TAC's requirement is for a tanker with a minimum indicated air speed of 250 kts. at 35,000 ft.

Gen. Weyland also said the Research and Development Command is presently investigating "various means" of improving TAC's critical, and increasing, deficiency in the tanker area by trying to find "something for less money" than the KC-135.

House Committee Steps Up OSI Attack

By Evert Clark

Washington—The Commerce Department's controversial Office of Strategic Information fought its second round before the House Information Subcommittee last week and failed again to convince the Congressmen that there was any reason for its existence.

OSI also drew the fire of the American Society of Newspaper Editors for its "morbid idea that we can gain strength by aping the totalitarian Soviet system of censoring everything."

Although OSI was created to control the release and publication of unclassified strategic information, its progress reports and minutes of its interdepartmental committee meetings were classified "Confidential" and its director, Erwin Seago, was cleared for access to "Top Secret" information.

Last week OSI, under subcommittee pressure, declassified slightly-censored versions of the progress reports. They revealed that OSI is working on programs to:

- **Control the release** of non-classified aerial photographs.
- **Encourage industry to report sales** of non-classified aerial photos "to individuals or firms unknown to them and to report suspicious cases to the local FBI or the OSI."
- **Get manufacturers to delete** "details on performance and other characteristics of a new weapon" from advertisements, even though the details are not classified. At OSI's suggestion, Defense Secretary Charles E. Wilson has "solicited the assistance" of the National Security Industrial Association. OSI said "this problem will require further attention and action."
- **Delete "information harmful** to our defense interests" from the Commerce Department's daily unclassified synopsis of U.S. government proposed Procurement, Sales and Contract Awards. OSI has asked Defense to revise Directives 5230.3 and 5230.4 so that "specific descriptions and quantities on awards and proposed procurements concerning new weapons and special installations" will be eliminated. OSI said this can be done "without interfering in any way with the intent and effectiveness of the publication" and without depriving industry and small business of needed information.
- **Obtain uniformity in the use** by government agencies of secrecy stamps such as "Official Use Only," "Restricted Distribution Only," "Administrative Use," etc. President Eisenhower's Executive Order 10501 established three secrecy classifications—Top Secret, Secret and Confidential—and said specifically that no other classifications should be used. In spite of this the Moss Subcommittee found that some 30 restrictive labels of the "Official Use Only" type now exist in executive agencies of the government.

Subcommittee Chairman John E. Moss (D.-Calif.) said he "detected an improvement in attitude" on the part of OSI Director Seago toward the handling of unclassified information since Seago's first appearance (AW Apr. 30, p. 29).

"But I still find myself considerably puzzled by the function of OSI, the need for it or the justification for its existence," Rep. Moss said.

He accused the Commerce Department of "an attempted power grab" in a dispute over whether the OSI should have power to establish policies for other government agencies, business and industry to follow in their handling of unclassified information—or whether OSI should give only "guidance."

A National Security Council directive issued in 1954 ordered the Commerce Department to create OSI to give guidance on the handling of nonclassified strategic information. Commerce, in turn, issued its own order setting up OSI. In that order, it passed along to OSI the authority given to Commerce by the NSC and said OSI "is responsible for formulating policies and providing advice and guidance to public agencies, industry and business and other private groups . . ."

Seago said on his first appearance that he could not comment on the NSC directive because it was classified. The subcommittee then obtained the directive and challenged Seago again last week on his policy-making powers.

Seago agreed that the Commerce order went far beyond the NSC's directive, but said he did not think OSI's activities had ever gone beyond NSC's intent.

However, OSI's third progress re-

Deadly Sparrow

Sparrow I missile trails smoke after being fired from an F7U-3M Chance Vought Cutlass. Photo was shot from another plane with a K-38, 24 inch camera.

port—written after Seago became director—uses the word "policy" in discussing almost every current and planned activity.

Seago said the Commerce order is now being revised—apparently to delete any policy-making authority.

"I have always felt it should be revised," he said.

Rep. Dante Fascell (D.-Fla.) answered: "I disagree with you. I don't think it should be revised because I don't think there is any need to even have it."

Seago was criticized severely for quoting this sentence from a House Appropriations Subcommittee's report that concerned itself with the Fiscal 1956 Defense Department appropriations: "Too much information has been released which is of no benefit to the American public, but which is of tremendous value to our opponents."

Chairman Moss wrote to Rep. George Mahon (D.-Tex.), head of the subcommittee issuing the report, saying the quote was "being used in an effort to suppress unclassified information."

Rep. Mahon, in his report on the Fiscal 1957 Defense appropriations report, again deplored "the continued leads and premature disclosures of our military secrets" and urged "more drastic administrative action" to curb them. He added, however:

"The committee trusts that the language in this paragraph will not be used by the Defense Department or any other government agency as a reason for withholding legitimate information from the press or public, nor should this paragraph be used as a cover up for inefficiencies and weaknesses of administration."

R. Karl Honaman, first director of OSI and later deputy assistant secretary for public affairs in the Defense Department, also had used the first Mahon quote. Honaman's name is signed to the first progress report on OSI's work. The report says in part:

"Despite the clear emphasis on its voluntary nature, the initial announcement of the establishment and objectives of the OSI stirred up the inevitable editorial protest from a small but highly vocal segment of the press. . . . It was certain in advance that (the American Society of Newspaper Editors' Freedom of Information Committee) would read 'censorship' into any suggestion that editors should use their informed judgment to protect American strategic interests."

It was in answer to this charge that Herbert Brucker, chairman of the Freedom of Information Committee said last week:

"The OSI thesis is that newspaper, magazine and other compilations of non-secret material might be of value to enemy spies. To argue this is to believe that enemy spies are too lazy or too stupid to do their job.

"The most disturbing thing about all this is the morbid idea that we can gain strength by aping the totalitarian Soviet system of censoring everything."

OSI's third progress report notes that Honaman's controversial "Balance Sheet for Strategic Information," which he drew up while at OSI and later used experimentally for a time in the Defense Department, "was subjected to some criticism. We agree that this appears to be impracticable."

The sheet asked government employes to decide whether release of a piece of information would be "helpful" or "harmful" to the interests of the U.S. on the basis of "net effect on military power," "net effect on industrial power," "effect on morale," "other strategic angles" and "other considerations (Anything you can think of)."

'Strategic Information'

The Office of Strategic Information defines "strategic" information as "unclassified scientific, technical, industrial or economic (non-statistical) information, the indiscriminate distribution of which may be inimical to the defense interests of the United States."

IATA Committee Near Compromise on Fares

Cannes, France—It's reported that International Air Transport Assn. is near a compromise on low transatlantic fare issue.

The fourteen-member working committee chairmanned by H. B. Main, Canadian Pacific Airline official, reportedly is near an agreement on one new 15-day excursion fare to go into effect in October. This is similar to the TWA proposal for special fares for two-week round-trip New York-to-London excursions. Instead of the TWA-suggested $350 fare, a fare of $425 has been mentioned.

New fare would apply on regular tourist flights so no re-equipment—a major objection of European airlines—

would be necessary immediately.

Compromise reportedly would put off new high density seating until April, 1958. However, committee compromise could be vetoed by any one of the seventy-odd airlines involved.

RMI Stand to Test Giant Rocket Motors

Denville, N. J.—A high-thrust rocket test stand capable of simulating in-flight attitudes and changes is under construction at a new privately financed facility of Reaction Motors, Inc.

The stand utilizes a new concept, says the company, to test rocket engines rated up to 500,000-lb. thrust in a vertical position and up to 200,000-lb. thrust in a horizontal one.

The new stand is only part of the evidence of the company's continuing growth, said President Raymond W. Young. The company is starting to reactivate its former main plant in nearby Rockaway which was vacated less than one year ago when the company moved into its new headquarters here. The Rockaway plant will provide another badly needed increment of 50,000 sq. ft. of floor space for expansion of product lines.

Present trend indicates the company's gross sales for this year will top last year's mark of $7.5 million by at least 80%, Young said.

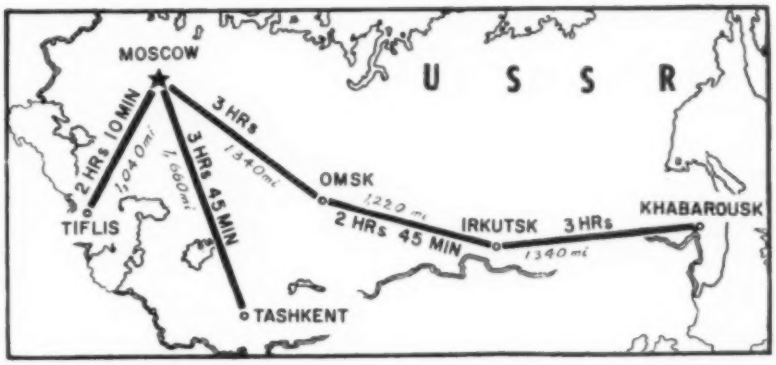
A major portion of that business can be expected to come from work deliveries against a USAF contract for gigantic powerplants for the rocket track expansion at the Air Force Flight Test Center, Edwards AFB. Other RMI programs underway in launching devices, chemistry and piloted aircraft powerplants are expected to contribute strongly to the sales figure.

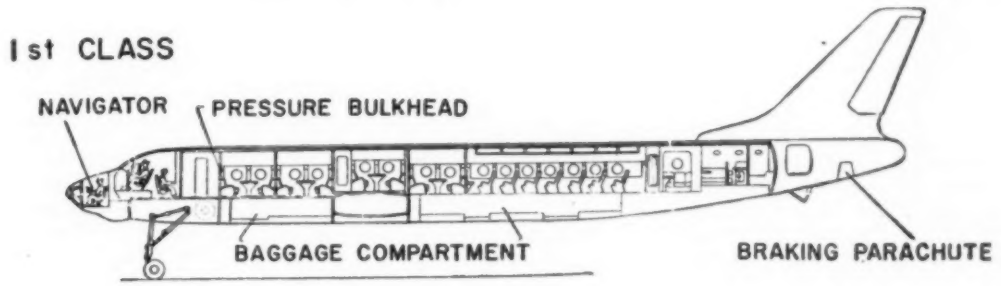
RMI's new test site is a 236-acre tract about one mile distant from the company's current active and expanded facility near Lake Denmark. RMI funds will be used to develop the site into a complete test unit, including the stand, control, instrumentation and data-recording centers and maintenance facilities.

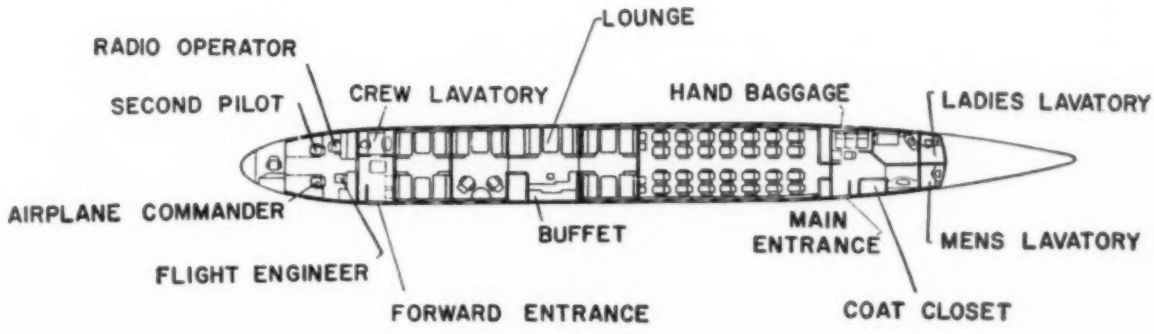
Development work at RMI includes rocket powerplants for missiles and aircraft, components such as turboprops, pneumatic regulators, ignition systems and flow controls. Major programs include work on solid and liquid chemical fuels, and combustion research. Rocket propulsion principles have been applied to novel designs for ejection seats and catapults.

Russian's Promote Tu-104 at Zurich Air Show

Brochures in the French language describing the characteristics of the Russian twin-jet airliner were distributed at the Zurich air show. The map shows typical flight times. First-class passenger configuration was shown. Tourist version will carry 70 to 80 passengers. Cruising speed is between 500 and 560 mph., with maximum speed of 625 mph. Other unqualified performance data: range—2,800 to 3,125 mi., takeoff run —4,600 to 5,200 ft., landing roll—3,600 to 3,900 ft., cruising altitude—32,500 to 39,000 ft., payload—15,000 lb. Cabin altitude ranges from 7,800 to 9,700 ft. at cruising altitudes.







Too Few Solutions to Today's Air Traffic

By Philip Klass

Boston—The aviation industry has too many possible solutions to its 1965-75 traffic control problems, and too few immediate answers for today's problems. These last are certain to get worse before they get better.

This pessimistic conclusion stems from reports made here by nearly 20 of the nation's top civil-military aviation planners and traffic control experts during the recent Spring Assembly of the Radio Technical Commission for Aeronautics.

The only ground for optimism is the fact that most segments of the industry, both civil and military, now appear to recognize the need for a truly Common System approach coupled with an integrated-system approach.

While several speakers suggested hopeful long-range solutions to the traffic control problem or described new techniques such as inertial guidance and Doppler navigators, other speakers, like Under Secretary of Commerce Louis Rothschild, reported new developments which will add to present problems.

New Philosophies

Three basic changes in Common System philosophy will be enunciated soon when the Air Coordinating Committee's Special Working Group 13 (SWG-13) releases its new report. These will add to present Common System traffic control problems. The new SWG-13 philosophies, according to Under Secretary of Commerce Louis Rothschild, include:

- **Military tactical operations** must be accommodated by the Common System in addition to the previous civil and non-tactical military operations.
- **Positive IFR (instrument flight rules) control** procedures in any weather will be required in high density areas. This concept, which recognizes the steadily widening gap between performance capabilities of different aircraft and the proficiencies of pilots who fly them, will require "vast improvements in the air traffic control system . . . to prevent economic or operational penalty to (airspace) users," Rothschild warned.
- **Area-type traffic control** in addition to the present route/airway type control. This requirement is imposed in part by military operations in the continental U.S.

Reporting on the Civil Aeronautics Administration's projected five-year program for new facilities, involving the expenditure of $246 million for new radar and traffic control equipments, CAA's Donald S. King indicated that:

- **Air Traffic Control Beacon program,** which is expected to provide major improvement in radar traffic control procedures, is still some years off. CAA does not expect to begin operational evaluation of the ATC beacon, with installations at New York, Washington, Norfolk and Chicago, until the summer of 1957. On this basis it would appear that it might be at least 1958 or 1959 before beacon implementation and use could begin.
- **Long-range traffic control radars,** which will provide airways coverage in the Boston to Norfolk to Chicago triangle, plus San Diego to San Francisco and Chicago to Kansas City, will be purchased this summer with Fiscal '57 funds. If CAA breaks with its previous tradition and buys military radars off present production lines, these could be operational by the summer of 1958, King indicated. However, qualified observers who are familiar with past CAA redesigns of military equipment for civil use, and the time CAA has taken to install and get CORs, DMEs, and surveillance radars into operation, predict that 1959 or 1960 is the earliest likely date for initial operation of new traffic control radars.

King was asked whether CAA might expedite its radar traffic control program by making use of SAGE air defense system radars. Although the CAA's five-year plan envisions that approximately 60% of its nationwide radar network will make use of military radars, it justifies the duplication of the remaining 40% on the basis that in some locations it may cost as much as $500,000 to remote the information from an existing military radar to a CAA center, only a little less than the $800,000 required to set up a civil radar, King said. He reported that CAA currently is conducting feasibility tests and economic studies on the remoting of military radar information.

SAGE Advice

SAGE design philosophies and know-how, and perhaps even the system itself, "can in principle be applied to the air traffic control problem," Dr. George E. Valley, Jr., associate director of Lincoln Laboratory (which developed SAGE) told the RTCA. Informal, after-hours studies of the air traffic control problem by interested members of Lincoln Lab indicate that the problem can not be solved by any apparatus substantially simpler than SAGE, and possibly it may be more complicated, Valley said.

Valley reported that a total of 10 million engineering man-hours spread over a six-seven year period, have gone into the development of the SAGE system. (This includes both the efforts of Lincoln Lab and its chief contractors.)

Valley also believes that a comparable number of man-hours will be required to solve the Common System traffic control problem, "unless a good deal of what has been devised and learned in the SAGE effort can be applied to the air traffic control problem."

Pointing out the many similarities and differences between the air defense problem which SAGE was designed to perform, and the traffic control problem for which it has been suggested, Valley pointed out that "until the problem has been defined far better (it is impossible to say) whether or not the SAGE apparatus is directly applicable in its present form, or whether some modification is required."

What Is Needed?

Several speakers, including Maj. Gen. Gordon A. Blake, USAF Director of Communications-Electronics and N. E. Halaby, Vice-chairman of the Aviation Facilities Study Group ("Harding Committee"), attributed the present traffic control impasse to lack of well-defined operational requirements and system planning, not to lack of avionic know-how or techniques needed to solve the problem.

Edward Curtis, special assistant to the President for aviation facilities planning, has launched a three-way program aimed at eliminating this roadblock to traffic control progress. Under Airborne Instrument Laboratory direction (AIL) the Cornell Aeronautical Laboratory and the Aeronautical Research Foundation are studying and will come up with reports on the anticipated traffic load during the next 20 years, the types of aircraft which must be accommodated and their flight characteristics, and the economics of air transportation during the next two decades.

With such information, a Curtis office team of engineers and operational people will lay out a master plan which defines the air traffic control problem and the system parameters necessary to solve it.

General Blake cautioned that the future Common System "from the start must be a single integrated system which includes navigation, traffic control, communications and identification.

We should not design it piecemeal, and then try to fit the pieces together." This is the philosophy

which the Air Force itself has adopted with its TRACALS (Traffic Control and Landing Systems) project which integrates the variety of projects under way in several Air Research and Development Command Centers, according to George B. Johnson, who described highlights of the TRACALS program. Johnson is Asst. Chief, Air Traffic Control and Navigation Division of the USAF Directorate of Systems Management.

Words of Caution

Pointing to previous mistakes and omissions in the nation's Common System efforts, RTCA speakers sounded the following words of caution:

- **"Major airports** must become components of a national aviation facilities system, matching the characteristics of aircraft, traffic control, navigation and communications rather than being mere local community projects" . . . N. E. Halaby.
- **"Congress can not be overlooked** if the maximum speed is to be achieved in solving the serious problems already facing civil aviation. Not only must the taxpayers be protected against duplication but all concerned must face up to the fact that we just don't have enough scientists qualified to work on these problems. We must therefore make maximum use of both money and brains." . . . Congressman Oren Harris, chairman, Subcommittee on Transportation and Communications, Committee on Interstate and Foreign Commerce.
- **"A single national traffic** control systems research and engineering facility, should replace the present separate CAA, Air Force, Navy and Army facilities." . . . N. E. Halaby.
- **"Inadequate airport facilities** and design, not traffic control problems, are primarily responsible for present delays." . . . Capt. J. D. Smith, Regional Safety Chairman, Air Line Pilots Association.

Boeing Grants Wage Boost to Employes

Seattle, Wash.—A two-year contract calling for increases in wages has been signed by union workers and the Boeing Airplane Co. The agreement calls for a 5% increase the first year, retroactive to May 22, and an automatic increase of seven cents an hour during the second year.

Second shift employes will receive an additional two cents an hour. Some 1,400 jobs have been upgraded with increases of about 10 cents an hour. Employes who have worked for the company 10 years or more will receive increased paid vacation time.

F-100s Set Up Tough Logistic Test

By Claude Witze

Bitburg AFB, Germany—The introduction of F-100 Super Sabre fighters to this base only eight flying minutes from the Iron Curtain may put the USAF intercontinental logistics system through its severest test yet.

The combat effectiveness of this supersonic North American fighter, which arrived here late last month, will depend almost entirely upon direct aerial resupply of spare parts from the U. S. There will be no European supply depot, vulnerable to Communist attack, serving the F-100 with spare parts.

Despite this fact, the 36th Fighter-Day Wing, commanded by Col. John A. Brooks III, plans to receive delivery of spare parts no more than one week after the filing of requisitions.

In years to come, the policy will be continued and expanded to cover all Air Force weapon systems in Europe and lead to the eventual abolition of at least one command, the Air Materiel Force, European Area. The command now serves all of Europe and North Africa, and its operations extend as far east as the Indian Ocean.

The long-range program, dictated by strategic, economic and political necessity, calls for the storage of all material within the U. S. Its adoption will lend new urgency to the USAF's crying need for more and better air transport equipment.

Maintenance Plan

From the standpoint of the 36th Wing's routine operational problems, the supply hurdle does not appear to be accompanied by a dangerous shortage of skilled personnel to maintain the complicated F-100. Col. Brooks says he has profited from the experience of earlier F-100 squadrons in the U. S. where the maintenance problem was a severe one because of the lack of trained personnel (AW Dec. 19, p. 14).

The danger that the combat readiness of the unit might be impeded by a shortage of skilled personnel led to preventive action before F-100 deliveries to Europe began.

One means of combating the technical shortage is embodied in a North American Aviation Corp. program to make on-the-spot maintenance easier and practical. In addition to a special North American spares representative based at Bitburg for each of the three squadrons in the 36th Wing, each unit also has its own NAA team of experts.

A team includes a competent field service representative assisted by experts in the fields of aircraft, hydraulics, electrical equipment, armament and propulsion. USAF officers and airmen alike depend upon these men for everything from know-how on the system itself to such things as the improvisation of test equipment.

In addition to the North American program, each squadron's maintenance is monitored by a representative of the engine manufacturer. Pratt & Whitney Division of United Aircraft, manufacturer of the J57 jet engine which powers the F-100, is prepared to expedite service and spares delivery to keep the 36th up to combat capability standards.

Manpower Requirements

All this does not mean, however, that the 36th is without a manpower problem. There are many new—i. e. only partially effective—airmen. The wing was undermanned when it had F-86 equipment, and the manpower requirement for F-100 operations is even larger.

At least 95% of the new men have never before seen a Super Sabre.

To help combat this factor, the 36th has established an elaborate mobile training unit to prepare the crews. The complexity of the F-100 makes this operation one of the most important at Bitburg.

Once this program becomes fully operational, maintenance officers of the 36th are confident they will support more flying time with the F-100 than was possible with the F-86—if the aerial pipeline delivers ordered spares on time.

For the time being, they will rely on North American and Pratt & Whitney personnel. The first of the North American teams, originally scheduled to stay with a particular squadron for 120 days, will have its tour of duty extended to six months.

How Direct-Supply Evolved

Like the military, representatives of the manufacturer place the greatest stress upon the spares delivery problem. While awaiting the activation of the direct-from-stateside requisitioning system, they kept aircraft in the air by going directly to the factory and obtaining parts within a week of the order, via commercial air service.

The USAF's direct supply system went into operation June 1.

The new concept of supplying overseas units with spares from a central Weapon System Storage site has been practiced on a trial basis by rotational units, mostly from the Strategic Air Command. Its success led U. S. Air Forces Europe (USAFE) to propose that F-100 units be placed on a direct-supply basis from the start.

Domestic Lines Call for Expansion Of CAB Investigation Into Fares

Washington—Domestic airline representatives last week called for an expansion of the forthcoming Civil Aeronautics Board fare investigation to cover all fares, including day and night-coach rates. Present plans would limit the study to the general-fare structure.

During hearings held to determine the issues to be included in the investigation, only the General Service Administration and the CAB counsel opposed the expansion. They argued that such a move would prolong and complicate proceedings.

Since it is up to the CAB to make the final decision on the scope of the investigation, present plans probably will not be changed.

The airlines, however, said the study should include:

- **Local-service airlines,** with any fare changes applying to all carriers.
- **Operating ratios,** as well as rate of return, as a basis for any rate formula.
- **Consideration of commitments** for jet transport purchases in arriving at any general fare revisions.

American Proposal

Howard Westwood, American Airlines attorney, urged that operating ratios be used as a guide in setting fares. He also warned against any order similar to one now existing for the air-freight field that would require airlines to seek an amendment every time a fare was filed.

Delta Air Lines Vice President Richard Maurer insisted that there was a direct relationship of standard fares with coach fares and that an across-the-board revision might jeopardize night-coach operations. Maurer said night-coach load factors are consistently falling because of the increase in day-coach service. He added that fares of the promotional type, such as round-trip discounts and family plans, also should be considered during the investigation.

Maurer warned that any study which fails to take account of the financial problems that will be encountered during the next five years of jet-transport purchasing would be unrealistic.

A. G. Hardy, National Airlines vice president, went further and asked that all the economics of the industry be studied as a part of the investigation. Hardy also called for a study of the incentive factor among carriers, stating that an aggressive airline should not be penalized by fare adjustments because of the inertia of less promotionally inclined operators.

Capital Airlines protested against any flat percentage changes of fares and urged adoption of modified terminal charges. Speaking for Capital, counsel Macon Arthur said that, because of the high costs inherent in short-haul operations, Capital would be in serious financial trouble but for the general $1.00 terminal fare increase of 1952.

Fare 'Hodgepodge'

The issue of high costs over short-haul routes was contested by George Spater, TWA counsel, who told the hearing that the investigation should begin with a complete overhauling of the basic fare structure, which he termed a "hodgepodge" and a "historical accident." He produced charts to illustrate the wide divergence of tariff rates despite similarity of mileage, a condition, he said, which has resulted from a lack of overall planning.

United Airlines warned that airline equities were not attractive to the small investors and that airlines were relying on banks and insurance companies for financial requirements. The airline's interest was not so much with the scope of the investigation but with its conduct since financial concerns could be influenced in their decisions by the trend of the investigation.

John Floberg, chairman of the Conference of Local Airlines, asked the CAB to include his organization in the investigation to prevent any disparity of fares. Previously, Floberg had testified that the local-service carriers were "considerably unnerved" by the "sweeping" fare investigation proposed by the CAB.

USAF Commands Told to Expand Reports on Base-Level Expenses

Washington—Base level maintenance expense, frequently an inaccurate guess in USAF cost estimates for each hour of flying, must now be reported in detail by all commands.

A new regulation (AFR 170-5) lists 54 aircraft on which maintenance cost information is required from 11 major commands. Included are most of the important operational planes, bombers, tankers, cargo planes, helicopters, fighters and trainers. A new USAF form, 494, is provided for base level maintenance cost estimates.

The regulation gives these reasons for compilation of the data:

- **Combined with depot level** maintenance costs, the figures will give USAF headquarters a reliable estimate of cost per flying hour when combined with factors for fuel, crew, aircraft attrition, etc.
- **They will help** in estimating the cost of flying organizations, special missions, etc. These data are needed to make decisions when cost is a serious factor.
- **The figures will set** standards for evaluating base level maintenance operations on a more accurate basis than in the past.
- **When reimbursable charges** are involved for use of aircraft, USAF will have, probably for the first time, an accurate basis for the charges.
- **They will help the** USAF make decisions on procurement of aircraft with limited maintenance experience.

Directorate of Management analysis is given responsibility for review and evaluation of cost factors. It also will decide the minimum aircraft models and series to be reported on by each command.

It is not essential that a major command order maintenance cost figures from all bases. Representative units may be selected if they will provide adequate coverage for a particular aircraft model and series.

First reports under the new regulation are due on Sept. 16. They will cover Fiscal 1956. They are ordered annually after that date.

Convair Announces Fort Worth Changes

Convair announces that the manufacturing organization at its Fort Worth plant is being subdivided into smaller segments. The move creates a number of changes in management personnel.

August C. Esenwein, Convair vice president and Fort Worth plant manager, said the change was brought about by the steadily increasing complexity of manufacturing projects at the plant over the past two years. He said the division of responsibility will permit more concentrated attention on fabrication, assembly field operations and electronics and mechanical subsystems.

An operations project office has been established to coordinate the individual project operations. Project administrators are to follow an assigned project, foresee trouble and coordinate solutions through line executives.

CAA Establishes Conditions in Certification of Turbine Aircraft

Washington—The Civil Aeronautics Administration has established special conditions for guidance in the certification of turbine aircraft. The new requirements supplement present Civil Air Regulations to compensate for differences between turbine and piston aircraft.

The special conditions, drawn up after a series of meetings between CAA and representatives of the airlines and the Air Transport Assn., will be used by CAA regional personnel.

Since the turbine aircraft covered are largely still in the blueprint stage, the rules are subject to change as the CAA, the airlines and the aircraft manufacturers develop more experience with this new type of transport.

The special conditions have been established to give turbine aircraft a level of safety equal to that specified for piston transports, providing CAA finds no features or characteristics in a turbine aircraft which make it unsafe for the transport category.

Foreign manufacturers also will have to meet the special requirements in order to have their aircraft certificated in the United States.

Since turbine aircraft are more sensitive to variations in temperature than piston engine types, the new rules specify full temperature accountability for turbine operations.

For takeoff, the CAA specifies that an aircraft must reach a height of 50 ft. at the end of the runway at standard temperature (59 degrees). The standard declines linearly as the temperature rises to a minimum of 20 ft. at a temperature of 109 degrees.

Similar conditions are specified for clearing obstacles. CAA says an aircraft should clear an obstacle on its flight path by 50 ft. at standard temperature, declining to a minimum of 20 ft. at 109 degrees.

CAA said turbine engine power used in scheduling performance should not be more than the rated engine power minus installation loss and normal power used by accessories.

An acceptable means of measuring engine power is to be provided, and the CAA said speed trimming, compressor blade cleaning or other reliable means can be used to maintain a fleet average power output, between overhauls, at the power used for scheduling performance.

In maintaining a fleet average of 100% of rated engine power, the CAA suggested that no individual engine be allowed to fall below 98% of rated power. A special airline group is studying this requirement and will make a further recommendation.

In applying its runway standards to turbine aircraft, the CAA will not give the aircraft credit for reverse thrust until more progress is made with thrust reversing mechanisms.

CAB, CAA Implement High Altitude Control

Washington—A high altitude quadrantal rule system which would apply to all flights operating under Visual Flight Rules at 29,000 feet and above has been proposed by the Civil Aeronautics Board's Bureau of Safety Regulation.

The Civil Aeronautics Administration also has announced the establishment of a central control unit in Kansas City to allocate air space to military aircraft at high altitudes. Known as the Central Altitude Reservation Facility (CARF), the unit is a step in the CAA program to control all air space at higher altitudes.

The proposed quadrantal rule system would provide aircraft with at least 2,000 feet vertical separation when operating VFR on reciprocal courses and at least 1,000 feet when flying on crossing courses. The 29,000 foot level was chosen because of altimeter errors and the increase in the number of high-speed aircraft at this altitude and above.

The Bureau of Safety Regulation pointed out that altimeter readings have erred by as much as 1,000 feet at the higher levels.

CARF will begin operations July 15. Jurisdiction of the new facility will be limited to air space at 14,000 feet and above east of the 100th meridian and 24,000 feet and above west of the 100th meridian.

The 100th meridian runs from a point in western Montana through central Texas.

Under the new procedure, all military requests for altitude reservations will be referred to CARF by individual CAA traffic control centers for allocation of air space.

Congress Approves Traffic Control Plan

Washington—Congress last week approved the full $40 million request by the Civil Aeronautics Administration to begin construction of its five-year federal traffic control plan.

Earlier, the House approved only $37.5 million.

The Senate recommendation, however, of $40 million was approved by conferees of the two houses.

Other final actions taken on the Fiscal 1957 budgets for the CAA and Civil Aeronautics Board were:

• **An allocation of $16.2 million** for payments of airline subsidies. CAB requested $20 million. The House voted

USAF H-21 Aiding Canadians

An H-21 helicopter of the 6615th Air Transport Squadron at Goose Bay, Labrador attempting to salvage engine of Canadian F-86 recently. F-86 crashed on frozen lake 70 mi. south of Goose Bay. RCAF crews prepared engine for helicopter lift, but project was abandoned when engine trouble developed in H-21. RCAF estimated F-86 engine weight at 2,500 lbs.

$15 million; the Senate, $17.4 million.

• **An allocation of $4,625,000** for CAB administrative expenses. The Board had requested $4.7 million.

• **An allocation of $128.6** million for CAA's administrative operations. CAA had requested $128.5 million.

The total $200 million appropriation approved for CAA's operations over the coming fiscal year compares with the $202.6 million requested.

USAF, Navy Have $9.6 Billion Balance

Washington—The Air Force and Navy had an unobligated balance of $9.6 billion as of May 1 for use in new aircraft and related-procurement contracts. The unexpended balance totalled $19 billion.

During the first ten months of Fiscal 1956—from July 1 through April 30—the two services obligated $5.3 billion for aircraft procurement: USAF, $3.9 billion; Navy, $1.4 billion.

On May 1, the USAF had an unobligated balance of $6.7 billion, Navy's unobligated balance was $2.9 billion.

Expenditures during the first ten months of Fiscal 1956 totalled $6.3 billion: USAF, $4.9 billion; Navy, $1.4 billion. This reflects a downward trend from the first ten months of Fiscal 1954 ($7.5 billion) and the first ten months of Fiscal 1955 ($7.2 billion).

OSR to Washington

Washington—USAF's Office of Scientific Research will be moved from Baltimore to Washington on July 1.

The new address of the office, which is responsible for the conduct of exploratory research programs, will be building Temporary T, 14th St. and Constitution Ave.

In announcing the move Lt. Gen. Thomas S. Power, commander of the Air Research and Development Command, said the shift had been planned since the summer of 1955. It was first reported in Aviation Week last July 18 (p. 12).

Thunderbirds

Air Force Thunderbirds, aerobatic team, have gone supersonic since receiving North American F-100 Super Sabres. Left to right: Lt. Bob Anderson, Tulsa, Okla.; Maj. Jack Broughton, Rochester, N. Y.; Capt. Billy Ellis, DeQuincy, La.; Capt. Ed. Palmgren, Winston-Salem, N. C., and Lt. Bill Pogue, Sand Springs, Okla.

News Digest

Aerojet General Corp. announced plans last week for the construction of a $13 million liquid-propellant rocket engine plant in Sacramento, Calif., to "substantially increase" the production of rocket powerplants.

At the same time, Aerojet said it was withdrawing from earlier plans under which it would have operated the USAF's rocket-engine production facility under construction at Neosho, Mo. Operation of the Neosho plant has now been assigned to the Rocketdyne Division of North American Aviation, Inc., and, with the Aerojet facility, will assure the Air Force of two sources of supply for quantity production of large rocket engines.

Construction of the Sacramento plant will begin immediately. Once in operation, it will require 1,000 employes.

Two Boeing YC-97J turboprop transports flew a total of 46 hrs. and 35 mins. during a 24-hr. period recently at Kelly AFB to set a new record for the Military Air Transport Service's 1700th Test Squadron. Previous high time recorded by the squadron was a total of 46 hrs. and 20 mins. flown by two Convair YC-131Cs during a 24-hr. period last September.

A Canberra jet aircraft which flew from London to New York and back in 14 hours and 22 minutes last year, setting a world record for Britain, will be used by the RAF flying college for world-wide training flights. It will replace Aries IV, another Canberra which has been in use at the college since 1953.

USAF definitive contract has been awarded Lockheed Aircraft's Georgia Division at Marietta for the manufacture of a "large quantity" of C-130 Hercules prop-jet military transports. Total value of contract is approximately $106 million. Air Materiel Command previously authorized $25 million. New authorization is for $81 million.

Maintenance and overhaul facilities of Lockheed Aircraft Service, Inc., formerly at Burbank, Calif., have been moved to Ontario International Airport at Ontario, Calif. Move involved a total of 1,260 tons of equipment.

Fighter Pilots of Marine Fighter Squadron 232, flying North American FJ-2 Fury jets, set a Navy-Marine flight record when they flew 2,558 hr. in one month. The previous high was beaten by 250 hrs. Twenty-one Furies and 52 pilots participated.

In aviation...
opportunity knocks twice

Now, both *military* and *commercial* aviation offer unlimited promise for an exciting, challenging and rewarding life. In both fields, Convair is today producing outstanding aircraft: *Military* aircraft like the supersonic F-102A all-weather interceptor ...faster, more comfortable *commercial* airliners like the Metropolitan 440. In the near future, the youth of America will have an even greater choice of careers through the development of atomic-powered military aircraft and vastly more advanced jet passenger planes. Aviation is the high road to opportunity for the youth of today.

CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION

Systems Engineering at The Ramo-Wooldridge Corporation

ICBM and IRBM are prime examples ■ The Intercontinental Ballistic Missile and the Intermediate Range Ballistic Missile, Air Force programs for which we have over-all systems engineering and technical direction responsibility, are prime examples of programs that require the systems engineering approach. Most Ramo-Wooldridge work is of such a systems character, requiring the concurrent solution of a wide variety of interrelated technical and operational problems. Additional examples at R-W are communications, fire-control, and computer programs for the military, and automation and operations research projects for business and industry.

Pertinent technical fields ■ Successful execution of systems engineering programs requires that the technical staff include experts in a considerable number of scientific and engineering specialties. At Ramo-Wooldridge some of the pertinent fields are aerodynamics, propulsion, digital computers, information theory, radio propagation, radar, infrared, servomechanisms, gyroscopy, and nuclear physics.

The kind of team required ■ A qualified systems engineering staff must include unusually capable theoreticians and analysts who can predict the behavior of complex systems, as well as ingenious experimental physicists who can devise suitable new techniques for measuring actual physical parameters. In addition, the team must include experienced apparatus and equipment development engineers, to insure a high level of practicability in the resulting end products.

Scientists and engineers who are experienced in systems engineering work, or who have specialized in certain technical fields but have a broad interest in the interactions between their own specialties and other fields, are invited to explore the wide range of openings at The Ramo-Wooldridge Corporation in:

Guided Missile Research and Development ■ Automation and Data Processing
Aerodynamics and Propulsion Systems ■ Digital Computers and Control Systems
Communications Systems ■ Airborne Electronic and Control Systems

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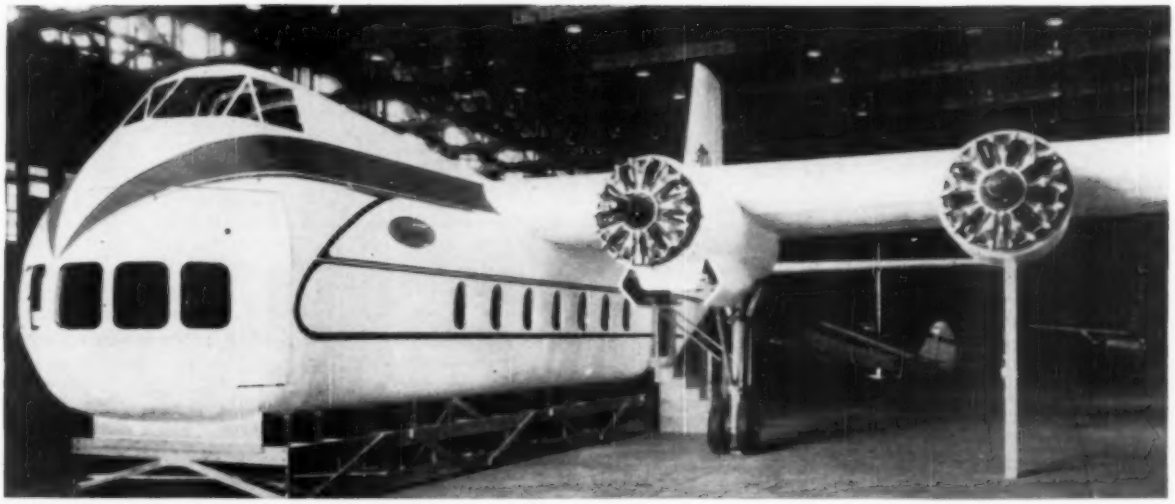
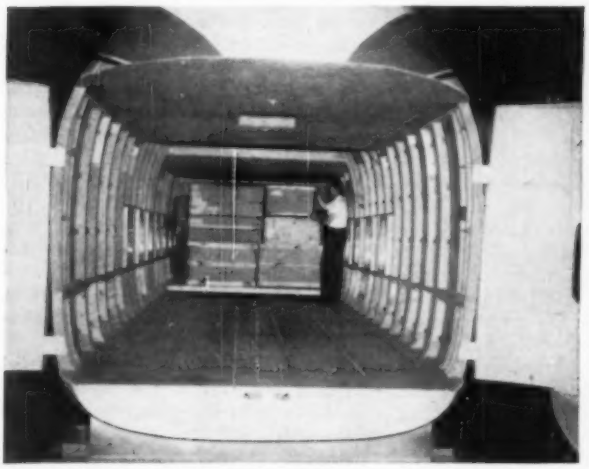


CLAMSHELL NOSE DOORS are 75-in. high and 106-in. wide, large enough to give trucks direct access to cargo compartment.

Safari Mockup Unveiled by Frye Corp.

Frye Corp. has unveiled a full-scale mockup of its F-1 Safari transport at the company's Fort Worth headquarters. The mockup shows built-in cargo system, clamshell nose doors and truck-bed height cargo deck that permit loading full cargo payloads during 10-minute stop. Safari has 25-seat passenger cabin. Spacing between seats is 39 in. to provide as much or more leg room than allowed in many luxury airliners. Frye's aim is for a simple, rugged airplane that can operate from small airports at lowest possible seat and ton-mile costs, be maintained with modest facilities and skills. Craft is on order for Cruzeiro do Sul of Brazil, Northern Consolidated Airlines and Wien Alaska Airlines. It is convertible from combination cargo-passenger to all-cargo or all-passenger.

TRUCK-BED HEIGHT cargo deck allows direct loading and unloading, eliminating fork lifts.



AIR FREIGHT is rolled into compartment on built-in tracks.

DECK LEVEL of passenger cabin permits small ramps.

HIGH LOAD FACTORS, engine reliability on Vickers Viscount sparked TCA plans for all-turbine transport fleet.

Trans Canada Plans All-Turbine Fleet

Vickers Viscount success leads to TCA plan for complete conversion to turbine aircraft by early 1961.

By L. L. Doty

Montreal—Trans Canada Air Lines plans to make a complete changeover to an all-turbine-powered fleet by late 1960 or early 1961.

The decision by the airline's top officials to move all the way into the turbine field was based largely upon their success with the turboprop Vickers Viscount and probably will bring about an order for the Douglas DC-9. The DC-9, if ordered, will fill the gap between the medium-range Viscount and the four intercontinental Douglas DC-8s already on order.

Reasons behind TCA's enthusiasm for the Viscount after its first year of route operations include:

- **Exceptionally low record** of engine failures.
- **Reduction of maintenance delays** because of the Viscount's efficient performance.
- **Passenger appeal** that exceeded TCA's original estimates.

Operational Problems

On the negative side, Trans Canada has been dissatisfied with the Viscount's:

- **Single-spar wing.** Because of TCA complaints, Vickers may move to a multi-spar wing.
- **Flame tubes** and first-stage compressor. Problems with these units have prevented the establishment of a 1,400-hr. overhaul period for the entire engine.
- **Air conditioning system.** A complete modification was necessary before adequate operation was accomplished.

Despite problems in these areas, the Viscount's over-all performance made it possible to all but by-pass the normal shakedown period, and it is now matching or out-performing the older, time-tested members of the TCA fleet —the DC-3, North Star (DC-4s equipped with Merlin engines) and the Super Constellation.

As an example of its performance, the number of Viscount flight delays due to powerplant failure per 100 revenue departures during the first year of service averaged .22.

This compares with 4.9 for the Super Constellation, 1.5 for the North Star and .21 for the DC-3.

Maintenance Record

The figure is particularly impressive in light of the delay report for April. Out of 2,177 Viscount departures during the month, only five flights were delayed because of engine or accessory malfunctions.

The Viscount has experienced an average of 2.89 maintenance delays per 100 revenue departures as compared with 8.8 for the Constellations, 3.9 for the North Star and .65 for the DC-3.

Several causes of maintenance delays, few of them serious, are being eliminated. In several instances, false warnings of freezing fuel filters have held up schedules. TCA mechanics at Winnipeg corrected this by relocating the filter pressure differential switch in the forward area of the engine. In other cases, freezing of the integrated portable water system drain was stopped by bleeding cabin air into the drain pipe.

During the month of April, the Rolls-Royce engines were never once feathered. This was equalled by the DC-3 but there were eight featherings on the Constellations and seven on the North Stars. In this respect, the Viscount holds undisputed first place in the TCA fleet. It has accumulated a total of 12,226 engine hours without a feathering. The DC-3's record is 11,184 hours with no featherings, while the North Star and the Constellation have reached 3,140 and 648 engine hours respectively without any featherings.

Overhaul Period

Engine overhaul period on the Dart engine originally was set at 750 hours. During the year, however, engine time was boosted to 1,400 hours. There are two exceptions—overhaul time for the flame tubes and the first-stage compressor has been cut back to 700 hours.

According to J. T. Dyment, TCA's director of engineering, problems created by both units have been solved, and he expects that the 1,400-hour period will be applied to the entire engine within a few months.

Rolls-Royce has redesigned the flame tubes to prevent early distortion by eliminating the wasp waist design and installing dual cooling strips. Both Aer Lingus and British European Airways have been getting 1,500 hours out of the new design, confirming test findings by Rolls-Royce.

TCA is replacing the old style tubes at each overhaul period so that all engines will be completely re-equipped by August.

Fatigue failure experienced in the first-stage compressor also has been cor-

rected by modifying the unit's natural frequency.

Overhaul periods on other TCA engines are:

- **Pratt & Whitney** R1830, 1,300 hours.
- **Merlin,** 1,250 hours.
- **Wright** 3350, 1,100 hours.

One Viscount has accumulated 3,000 hours since entering service, and the fleet of 18 Viscounts delivered thus far had built-up a 29,000-hour total at the end of April. (In all 36 Viscounts have been ordered, with delivery scheduled for completion by the spring of 1958.)

Unscheduled engine changes per 1,000 hours during the year averaged .08 for the Viscount as compared with 1.92 for the Super Constellation, .55 for the North Star and .36 for the DC-3.

JP-4 Gets Nod

Dyment said TCA is not considering a conversion from the 506 engine to the Rolls-Royce 510 recently adopted for Capital Airlines' Viscounts. He reasons that the cruise power of both engines is roughly the same and that the lower takeoff power of the 506 is offset by its 200-pound savings in weight.

Dyment says he is fully satisfied with TCA's experience with JP-4 fuel and has no thought of switching to kerosene which Capital uses as fuel. He gives these reasons:

- **JP-4 is cleaner.**
- **Gives more positive** starting.
- **Is less hygroscopic** then kerosene.

Dyment also claims that the wide use of JP-4 by the military will have a favorable effect on distribution costs and that JP-4 eventually will be considerably cheaper than kerosene.

Thus far, cold weather has not disrupted operations, probably because flame interconnecting tubes were increased in diameter, high energy ignition was adopted and a synthetic low viscosity lubricating oil was introduced by Rolls-Royce.

Crew Response

The Viscount's success is attributable to two basic factors according to Dyment:

- **Engine has been** trouble free from the very beginning.
- **The 250 pre-delivery** modifications insisted upon by the airline have forestalled the various maintenance problems customarily associated with new airplanes.

Pilots, generally enthusiastic about the Viscount, are especially pleased with the cockpit layout. They like the fact that the Viscount has fewer instruments, switches and lights than other comparable transport airplanes—242 on the Viscount as compared with 387 on the DC-6, 612 on the Super Constellation.

Other features which crews praise are ground fine pitch, automatic retarding, anti-skid brakes and automatic engine control. But they have objected to a stiffness in nose wheel steering. Also, Dyment expressed dissatisfaction with the wheels and said the tires were not standing-up to the life expectancy of at least 1,000 landings.

No one has a kind word for the original air conditioning system. Crews have been discomfited by the heat generated by the electronic units located to the rear of the cockpit, and the system has been the source of the only major complaint received from passengers.

TCA found that ducting was too small in diameter, resulting in friction losses. Technicians also learned that stagnant air was created around the cabin ceiling area because of the location of the air in-and-out ducts at floor level. Furthermore, the position of the temperature sensing unit at ceiling height caused slow actuation and extreme swings between hot and cold.

An aspirator has eased the cockpit heat problem, and the entire air conditioning system has been modified to correct the foregoing flaws in order to attain more efficient performance. Nevertheless, TCA has not stamped the remodeled system as entirely ideal.

Ground operations' personnel like the accessibility of the Viscount—under-wing refueling and loading of all cargo bins except the tail bin without the need of cargoveyors.

Passenger Appeal

Although the wind milling of propellers has not posed a problem, as a precautionary device TCA has designed "prop-socks," a pair of leather boots which fit over propeller tips and are connected to one another by a nylon cord.

Passenger appeal of the Viscount is best demonstrated by the load factor which has been high throughout the twelve months of Viscount service. Most recently, it has ranged from a low of 81% in May to a high of 85.7% in April.

Viscount service is centered around the New York-Montreal-Toronto-Ottawa markets, but service also is offered over transcontinental routes on intermediate schedules.

Some Viscount flights on the transcontinental routes reached a load factor of 95% for the month of April.

Sales officials are making the fair assumption that TCA is capturing a lion's share of passenger traffic because of the Viscount.

Federal Airport Aid

Washington—Federal aid airport funds totaling $51,863,177 have been allocated to 368 projects for the 1957 fiscal year beginning July 1.

The distribution is an annual installment of the four-year $252 million program under which $63 million will be available for matching funds each year. The full 1957 amount has not yet been allocated because some communities have not submitted eligible requests. Unused funds will be set aside until the end of Fiscal 1958.

Airports scheduled to receive the top amount of $1,250,000 are: Atlanta, Chicago (O'Hare), Los Angeles (International), Miami, Minneapolis-St. Paul, New Orleans, New York (International) and Oakland.

Detroit (Wayne) and Nashville will receive $1 million each. Federal aid to projects in Alaska will total $1,155,000 and in Puerto Rico, $609,242.

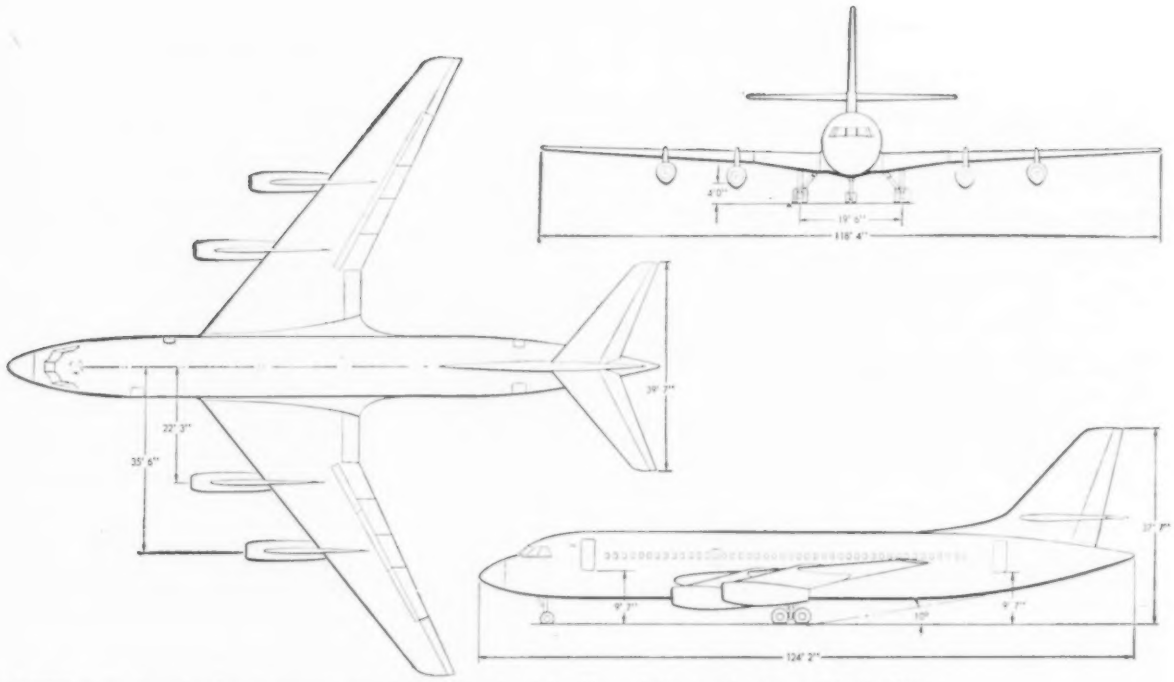
The Viscount, they feel, has increased the scope of the air travel market in areas in which it operates. The airplane's popular appeal, they surmise, has lured travelers from surface transportation, and all air carriers have benefited, a trend which TCA feels will be accelerated even further with the advent of the jet transport.

Such an assumption can be drawn from traffic growth figures in the Montreal-New York market. Between these two cities, 43,488 seats were offered for sale during the first five months of 1955, and 30,717 passengers were carried. Over this route during the same period in 1956 with the Viscounts in service, 67,680 seats were offered for sale and 53,344 passengers were carried. This is a 55% increase in seats scheduled, and a 73% increase in the number of passengers carried.

So successful has the Viscount been during its first year of operation that it is no longer featured in TCA's Canadian advertising. In the U.S., advertising in national magazines and newspaper media stresses the Viscount but engine characteristics are played lightly, a reverse twist over original ad copy.

Before the Viscount was launched into service, advertising was educational in context. Turbine technique was reduced to layman's language in an effort to acquaint the public with the virtues of gas turbine power.

But TCA's ad men now feel that passengers are content to enjoy the comforts of the Viscount without concerning themselves over the reasons for such comfort. As a result, "turboprop" or "Rolls-Royce" takes a back seat to such selling points as "service," "quiet" and "comfort."



LATEST three-view showing measurements of Skylark ordered by Howard Hughes for Trans World Airlines.

TWA, Delta Order Convair Skylark 600

Trans World Airlines and Delta Air Lines placed orders for the Convair Skylark 600 last week, giving Convair the start it needed to get the $3.5 million jet transport into production.

Howard Hughes ordered 30 Skylarks for TWA, and Delta ordered 10 of the medium-range jet transports. Convair hopes to have a prototype flying by 1959 and deliveries under way by 1960.

Aeronaves de Mexico, a Pan American World Airways affiliate, is negotiating for five Skylarks, and both United Air Lines and VARIG Airlines of Brazil are reported highly interested in the new transport.

New Transport Dimension

The decision to produce the Skylark introduces an important new factor in the jet equipment pattern. When the airlines began ordering turbine equipment last fall, it appeared that the carriers would buy the Boeing 707 and the Douglas DC-8 turbojets for long-range operations and that they would use turboprop airplanes, such as the Lockheed Electra, for the medium-range routes.

Now TWA and Delta have cast their lot with the turbojet for both types of operation. United is the only member of the Big Four still to decide on a medium-range transport.

TWA previously ordered the Boeing 707 for its long-range operations, as did American Airlines, Braniff Airways and Continental Air Lines. Delta decided on the DC-8, along with Eastern Air Lines, United and National Airlines. Northwest Airlines and Northeast Airlines are not yet committed for jet orders.

Production Assured

In the medium-range field, American, Eastern, National, Braniff and Western Air Lines have ordered the Electra, and Continental has ordered Viscounts. Capital Airlines now operates the medium-range Viscount and is shopping for a larger, longer-range turbine transport.

This well-established pattern of using turboprop transport for medium-range operations is upset with the introduction of the Skylark, and now the carriers can standardize on the turbojet for operations of over 250 miles.

Convair says its production break-even point is 65 aircraft, but the board of directors decided to start production as soon as orders for 40 Skylarks were in. When TWA and Delta ordered last week, production was assured.

The Skylark is a four-jet transport that will be powered by the General Electric CJ805, commercial version of the military J79. The engine develops 10,000 lb. dry static thrust.

The transport is being offered as a medium-range turbojet which will operate out of the country's smaller airports with runways too short to handle the longer range DC-8 and 707. Landing roll of the Skylark is specified at 5,000 ft. It also has the range to fly over transcontinental routes.

The speed of the Skylark at 25,000 ft. at maximum cruise power has been set at 607 mph. Maximum weight for takeoff is 173,500 lb., maximum landing weight, 123,500 lb. Payload ranges from 21,700 lb. for an 80-passenger configuration to 25,000 lb. for coach (113 passengers) and mixed configurations.

The Skylark's wings are swept back 35 degrees, and the wing span is 118 ft., 4 in. The fuselage, originally scheduled for 118 ft., 5 in., has been lengthened to 124 ft., 2 in. The rudder tip stands 37 ft., 7 in. above the ground.

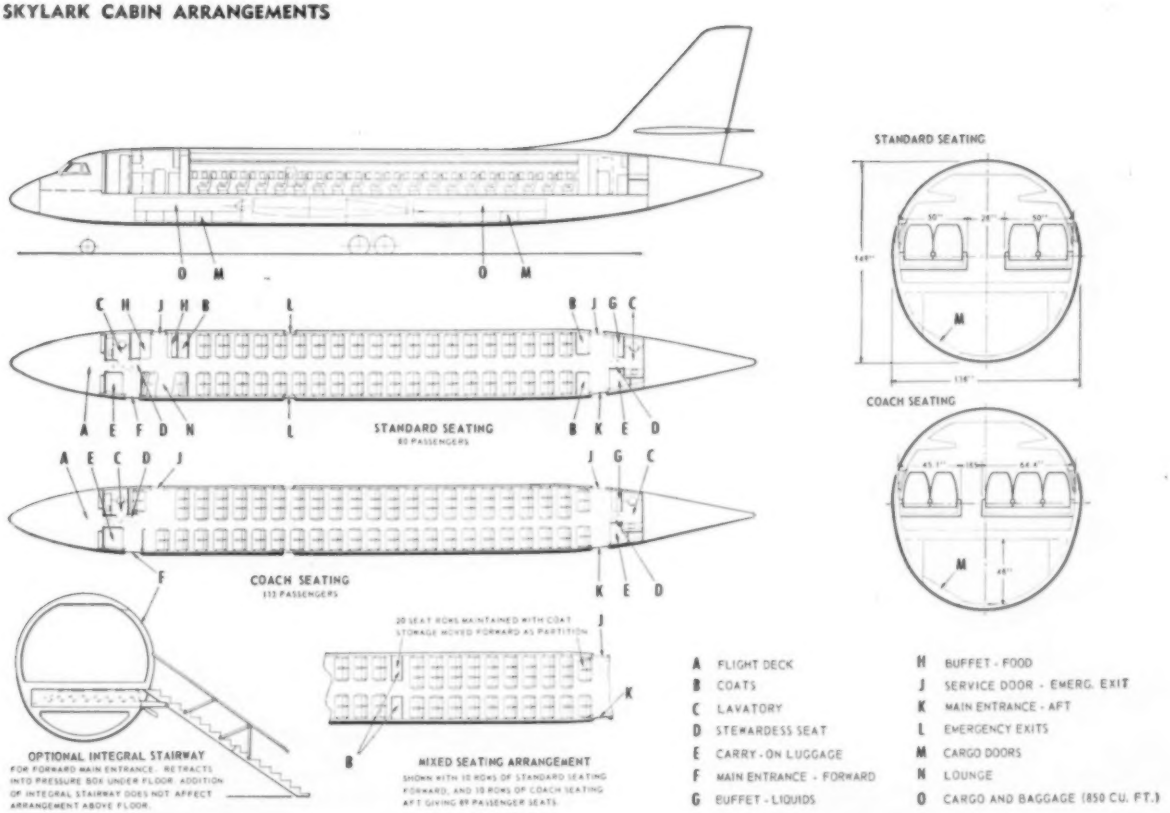
CAB Will Investigate New Transport Plan

Washington—The Civil Aeronautics Board has decided to launch a full dress investigation of the Hughes Tool Co. proposal to build jet transports and sell 25 of them to Trans World Airlines.

The investigation is designed to determine whether Hughes' proposal calls for a reassessment of current approval of the control of TWA by Hughes Tool Co. and whether the CAB should approve a Hughes-TWA deal for jet transports.

Hughes now controls TWA with

SKYLARK CABIN ARRANGEMENTS


STANDARD SEATING
80 PASSENGERS
COACH SEATING
132 PASSENGERS
OPTIONAL INTEGRAL STAIRWAY
FOR FORWARD MAIN ENTRANCE. RETRACTS INTO PRESSURE BOX UNDER FLOOR. ADDITION OF INTEGRAL STAIRWAY DOES NOT AFFECT ARRANGEMENT ABOVE FLOOR.
20 SEAT ROWS MAINTAINED WITH COAT STOWAGE MOVED FORWARD AS PARTITION
MIXED SEATING ARRANGEMENT
SHOWN WITH 10 ROWS OF STANDARD SEATING FORWARD, AND 10 ROWS OF COACH SEATING AFT GIVING 89 PASSENGER SEATS.
STANDARD SEATING
COACH SEATING
A FLIGHT DECK
B COATS
C LAVATORY
D STEWARDESS SEAT
E CARRY-ON LUGGAGE
F MAIN ENTRANCE - FORWARD
G BUFFET - LIQUIDS
H BUFFET - FOOD
J SERVICE DOOR - EMERG. EXIT
K MAIN ENTRANCE - AFT
L EMERGENCY EXITS
M CARGO DOORS
N LOUNGE
O CARGO AND BAGGAGE (850 CU. FT.)

CAB approval. The Board approved the relationship in 1944 but limited transactions between the two companies to $200 each and a total of $10,000 a year.

When the CAB approved Hughes' control of TWA, the agency found that Hughes was not producing aircraft, parts or facilities for commercial air transportation and had no plans to get into the field. Later, Hughes began aeronautical work for the military agencies, but the CAB continued its approval.

The new Hughes proposal changes the picture because it moves the company into the commercial field.

Hughes says it plans to build a jet transport that would be superior to types that are currently being offered to the airlines.

TWA has asked for permission to buy up to 25 of the aircraft, and Hughes says it will sell to other airlines at the same price it charges TWA.

Continental Announces Dividend of 12½ Cents

Continental Air Lines declared a quarterly dividend of 12½ cents per share of common stock outstanding as of June 15 at a special board of directors meeting in Denver. The dividend is payable on June 30.

Four Airlines Receive New Logair Contracts

The four airlines now conducting domestic Logair operations for the Air Materiel Command have won contracts to fly the system during the coming fiscal year.

Resort Airlines, Capitol Airways, Riddle Airlines and American Air Export and Import Co. were the successful bidders among 14 airlines for a total of $15.5 million in Logair contracts for the continental United States.

The bidders submitted alternate proposals for Fiscal 1958 and 1959 along with their bids for Fiscal 1957, so AMC has the option of extending the Fiscal 1957 contracts to 1958 or 1959. Extension of the contracts depends upon availability of funds and acceptable performance by the carriers.

The Logair contractors will fly about 125 million ton-miles of cargo by the end of Fiscal 1956, and AMC estimates that the airlines will operate 200 million ton-miles in the coming fiscal year.

In Fiscal 1957, Logair will operate 41 aircraft, including eight C-54s and 33 C-46s. Resort Airlines will conduct C-54 operations, and the other three carriers will operate C-46 aircraft.

Resort Airlines won a $5 million contract for operations in Pattern One, with a main route from McChord AFB, Washington, to Dover AFB, Delaware, via Travis AFB, California; Hill AFB, Utah; Wright-Patterson AFB, Ohio and other points. The contract calls for the airline to fly a minimum of 409,398 mi. a month and an annual total of 4,911,936 mi.

Capitol Airways has a $3.7 million contract for Pattern Two operations between Travis AFB and Dover AFB. The carrier will fly a minimum 546,790 mi. a month and 6,561,474 mi. a year.

Riddle Airlines will operate a $3.1 million contract on Pattern Three. Riddle will cover the route between Olmsted AFB, Pa., and Loring AFB, Maine, and will fly a monthly minimum of 400,786 mi. and an annual minimum of 4,809,432 mi.

AAXICO will operate Patterns Four and Five on its $3.7 million contract. Pattern Four covers routes in Oklahoma, New Mexico, California and Utah with a monthly mileage of 418,414 and a yearly total of 5,020,968. Pattern Five starts at Hill AFB with operations to Ellsworth AFB, South Dakota; Malmstrom AFB, Montana; Fairchild AFB, Larson AFB and McChord AFB, Washington, then back to Hill AFB. The contract is for 74,673 mi. per month and 896,075 mi. a year.

Ship fast

UNITED'S radar-equipped DC-6A Cargoliners® are the world's fastest commercial cargo planes!

UNITED alone links all the major markets in the East, Midwest, *all* the Pacific Coast (and Hawaii)!

Ship sure

UNITED specializes in scientific handling. One example: recessed-wheel pallets to speed loading!

UNITED provides extra care in moving heavy pieces —the DC-6A's Motorized Tug Bar does it!

Ship United

UNITED guarantees you space dependability through its centralized Customer Service system!

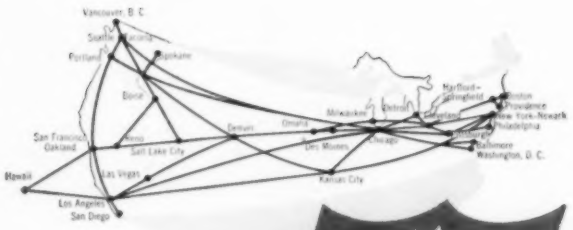
UNITED also offers reserved Air Freight space on *all* equipment—and Telemeter Airbill service!

Examples of United's low Air Freight rates

*per 100 pounds**

CHICAGO to CLEVELAND	$4.78
NEW YORK to DETROIT	$5.90
DENVER to OMAHA	$6.42
SEATTLE to LOS ANGELES	$9.80
PHILADELPHIA to PORTLAND	$24.15
SAN FRANCISCO to BOSTON	$27.00

*These are the rates for most commodities. They are often lower for larger shipments. Rates shown are for information only, are subject to change, and do not include the 3% federal tax on domestic shipments.



UNITED AIR LINES

For service or information, call the nearest United Air Lines Representative. Write for free Air Freight booklet, Cargo Sales Division, Dept. J-6, United Air Lines, 5959 S. Cicero Ave., Chicago 38.

New Tyne Engine to Improve Vanguard

Weybridge, England—Development of the new Rolls-Royce Tyne turboprop engine will enable the Vickers-Armstrongs Vanguard transport to carry 115 tourist passengers at up to 425 mph. on stage lengths to 2,600 mi. This should take place between 1959 and 1963, according to detailed plans just disclosed. Early versions will cruise at 400 mph. at maximum landing weight of 108,500 lbs.

Immediate plans call for a three-stage development of the Tyne engine from the 4,470-ehp. version fitted in the initial models of the Vanguard to a 5,500-ehp. powerplant available in 1963. The engine program will be aided by the "built-in stretch" of the plane's structure, which will enable it to take progressively more powerful engines without altering the basic airframe, Vickers points out.

Production Version

The Rolls-Royce Tyne program comprises these stages:

- **Stage 1** will be the first production version, available for 1959 delivery, having a 4,470-ehp. takeoff rating.
- **Stage 2** ready in early 1961, with a takeoff rating of 5,075-ehp., will feature a turbine disk cooling system and turbine blade materials allowing operation at higher temperatures.
- **Stage 3,** available in the first half of 1963, will have high-pressure turbine blade cooling, allowing a takeoff rating of 5,500 ehp.

Initial delivery of the Vanguard will be made in the spring of 1960, to British European Airways, which has 20 ordered, with 1960 delivery also offered to other potential customers. First flight of the new transport is scheduled for autumn 1958. Price is approximately $2.1 million.

Vickers-Armstrongs has completed the basic design of the Vanguard at its Weybridge plant and production is in the initial stages. First components will be used for static and dynamic testing.

Latest Data

Latest data supplied by the manufacturer show some slight changes in the Vanguard design since it was first announced. Wingspan is the same 118 ft. revealed earlier, but the fuselage is now 122 ft. 4-in. long, compared with the previous figure of 118 ft. 1 in. The upper deck has a radius of 69 in. and the lower freight deck has a 64-in. radius. Height is 35 ft. Maximum takeoff weight is 135,000 lb., the same as stated previously.

The Vanguard can carry 15,000 lb. of payload in the freight holds. Thus, with only 50 passengers aboard, the aircraft will be able to operate at its full load without any shift in the passenger compartment. Without affecting passenger capabilities, an airline could use its Vanguards at night or other off-peak periods as pure freighters since it will be possible to operate them economically with freight only.

With reserve fuel for a one-hour hold at 5,000 ft. and diversion of 230 statute mi. long-range flight, the transport will be able to operate from a 6,000-ft. runway at maximum gross weight with maximum payload of 21,000-lb.

A comparison of the seat-mile costs between the 93-passenger Vanguard and a 44-passenger Capital Airlines Viscount over a 400-mi. stage shows a cost of 1.32 cents for the Vanguard against 1.6 cents for the Viscount.

The Vanguard was designed for smooth integration with a Viscount fleet. Its main electrical system, for example, is 28-volt so it can be started off a Viscount power truck. Vickers also was determined that the Vanguard should be as simple to maintain as the Viscount.

Since the Vanguard is not an aircraft for a small airline, Vickers plans to continue Viscount production even after the Vanguard is phased in.

Market Estimate

The company estimates the total potential market for Vanguards at between 100 and 500 aircraft.

The Vanguard is designed to cruise at 24-28,000 ft. for maximum range and at 20,000 ft. for maximum speed. Pressurization is the same as the Viscount at 6.5 psi., employing two engine-driven compressors. Either compressor will maintain full cabin pressure differential. The system provides sea level pressure to 15,000-ft., and 5,000-ft. cabin pressure up to 25,000-ft. Windows are the 26 in. x 19 in. elliptical size which has proved popular in the Viscount.

Fuselage can be arranged to carry 76 passengers in the luxury version, 93 in standard comfort, or 115 in the high-density configuration.

The spacious cockpit is designed to SAE standards. Pilot and co-pilot seats are flush against the control pedestal, being entered from the window side. Although there is provision for a flight engineer seated to the rear of the pilots, it is possible to operate the aircraft with only a two-man crew and there is no flight engineer panel as such. The cockpit also has a fourth seat hinged to the rear bulkhead.

Weather radar in the nose will be standard equipment. There is ample space for radio equipment at the rear of the cockpit, with provision for the deeper American equipment.

There are fore and aft passenger doors, with folding stairs, and also two full-height emergency doors opposite the main doors. These serve double duty as service doors for the galleys. Additional emergency exits are two over-wing cabin windows on each side with four more adjacent to the doors. There are 38 cabin windows.

The two large cargo compartments in the lower deck are located fore and aft of the wing. The forward compartment will hold 800 cu. ft. and the aft, 630 cu. ft.

Unusually large doors to each compartment, 5-ft. 6-in. wide 4-ft. 3-in. high provide easy cargo access.

The freight deck is pressurized and access to it is possible in flight.

Conventional Structure

The 118-ft. span wings are an integral structure based on three-spar construction and closely spaced ribs. Manufacturing joints are at the root and just outboard of the outer engines. The square wing tips and leading edges are detachable. The wing taper is not straight but is cranked slightly at the aileron root. Wing area is 1,529 sq. ft. Aspect ratio is 9:1, dihedral 6 deg., incidence 2¼ deg. Thickness chord ratio is 15% at the root, 13% at the tip. Tail dihedral is the same as that of the Viscount, 15 deg.

Ailerons and other control surfaces are conventional in a manual system without boost. The system employs push-pull rods and uses torque tubes with rotary seals where it passes through the pressure hull.

Single-Point Refueling

All fuel is carried in the wing and the Vanguard is equipped with a single-point refueling system with the fueling point situated under the wing adjacent to the fuselage. Vickers says complete fueling for a 1,500-mi. flight can be accomplished in 10 minutes. Overwing filler caps also are provided. There are two integral tanks in each wing, carrying a total of 6,120 U. S. gallons.

Wings are thermally anti-iced by means of exhaust-heated air passing through heat exchangers. Propellers, engine air intakes, and tail are de-iced electrically.

A 3,000-lb. hydraulic system powers undercarriage, flaps, brakes and nose-wheel steering. A separate hydraulic system is provided for the built-in stairs and there is an independent emergency system for flap operation. Brakes are equipped with anti-skid devices.

ESSO AVIATION TURBO OIL 35

ONLY OIL APPROVED FOR LUBRICATING VICKERS VISCOUNT TURBO-PROP ENGINES

An exclusive Esso achievement... Esso Aviation Turbo Oil 35, a synthetic product, is the *only* gas turbine lubricating oil approved by Rolls-Royce, makers of the four "Dart" turbo-prop engines powering the Viscount "700" Series.

Only a *synthetic* lubricating oil can meet all the exacting requirements of these turbine engines; they cannot be met completely by a mineral oil, even of the highest quality.

This is another Esso "first," result of technical *research* and *foresight* on the part of Esso aviation lubrication specialists working in close cooperation with British and U. S. aircraft engine designers and builders.

Esso Aviation Turbo Oil 35 used by the following Viscount operators: British European Airways • Air France • Air Lingus • Trans-Australia Airlines • Trans-Canada Air Lines • Capital Airlines • British West Indian Airways • Linea Aeropostal Venezolana • Hunting Clan Air Transport Ltd. • Canadian Department of Transport • Butler Air Transport Ltd. • Braathens S.A.F.E. • Misrair S.A.E. • Indian Air Force • Iraqi Airways • Middle East Airlines • Central African Airways

Esso

INTERNATIONAL AVIATION PETROLEUM SERVICE

Airline Traffic — April 1956

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	Per Cent Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	648,619	381,494	**71.68**	1,599,609	820,412	4,827,548	**44,538,636**	**61.73**
Braniff	151,161	60,980	**63.91**	189,314	117,829	295,064	**6,444,580**	**55.75**
Capital	240,765	78,619	**65.25**	243,519	171,651	267,112	**8,197,115**	**48.47**
Colonial	32,895	8,319	**57.07**	13,391	5,991	29,899	**842,541**	**57.70**
Continental	57,360	20,700	**51.46**	65,675	23,692	99,559	**2,175,493**	**43.60**
Delta	209,332	102,246	**67.14**	295,734	225,238	557,563	**10,938,616**	**60.90**
Eastern	647,218	353,191	**66.40**	919,002	373,718	1,021,551	**39,027,353**	**52.72**
National	139,231	103,098	**69.28**	269,553	65,681	432,119	**11,319,418**	**67.95**
Northeast	41,826	8,338	**58.64**	9,954	14,060	23,528	**821,801**	**57.80**
Northwest	104,409	64,154	**59.99**	314,748	186,194	565,275	**7,481,664**	**52.64**
Trans World	333,000	243,457	**62.53**	917,470	627,842	1,694,452	**26,555,310**	**56.83**
United	489,007	326,918	**64.08**	2,186,419	907,690	3,148,399	**37,652,954**	**56.51**
Western	83,412	38,152	**60.52**	191,735	70,349	132,370	**4,038,928**	**60.39**
INTERNATIONAL								
American	10,733	7,445	**68.76**	11,050	419	245,009	**1,039,930**	**70.28**
Braniff	2,415	5,038	**43.72**	19,654	.....	72,295	**660,464**	**47.99**
Caribbean Atlantic	16,979	1,234	**55.31**	1,059	.....	2,692	**115,793**	**52.74**
Colonial	4,227	3,267	**70.00**	232	.....	3,580	**362,485**	**73.88**
Delta	4,430	4,745	**54.54**	6,589	.....	51,990	**543,028**	**44.47**
Eastern	16,869	23,836	**58.22**	53,618	.....	57,032	**2,697,816**	**53.18**
National	10,377	6,366	**62.64**	9,094	3,451	23,965	**701,679**	**67.07**
Northwest	8,694	17,210	**57.79**	894,840	15,243	806,188	**3,643,880**	**68.19**
Pan American								
Alaska	6,147	8,371	**65.49**	36,875	.....	301,611	**1,234,428**	**53.51**
Atlantic	75,748	80,902	**62.31**	881,225	.....	1,710,526	**11,253,772**	**60.78**
Pacific	22,241	67,244	**76.50**	1,010,088	.....	1,513,041	**9,658,060**	**71.52**
Latin America	97,259	84,746	**61.78**	315,408	.....	2,866,084	**11,409,378**	**58.42**
Panagra	12,205	13,843	**58.88**	52,883	.....	281,290	**1,820,930**	**57.31**
Trans World	21,811	52,382	**61.46**	736,303	.....	726,021	**7,027,565**	**66.09**
United	7,866	19,527	**69.24**	100,791	.....	71,141	**2,210,104**	**63.90**
LOCAL SERVICE								
Allegheny	30,795	4,984	**47.15**	6,431	15,889	3,512	**501,050**	**47.87**
Bonanza	11,667	2,558	**46.91**	4,104	2,230	5,063	**253,570**	**44.73**
Central	10,903	1,705	**35.74**	3,467	2,055	4,728	**173,347**	**31.79**
Frontier	14,229	3,829	**44.59**	15,930	7,099	46,915	**436,129**	**53.31**
Lake Central	11,372	1,740	**37.36**	2,236	10,456	.....	**174,173**	**36.35**
Mohawk	28,496	5,180	**57.05**	4,834	7,695	8,937	**515,179**	**56.74**
North Central	43,173	6,311	**57.91**	17,542	26,936	.....	**648,620**	**46.60**
Ozark	25,976	3,921	**37.25**	8,347	14,792	3,926	**393,736**	**37.87**
Piedmont	34,835	6,567	**56.11**	12,486	9,144	10,893	**660,930**	**55.43**
Southern	16,204	2,764	**47.58**	8,177	10,919	.....	**284,064**	**45.13**
Southwest	20,288	4,009	**44.95**	6,466	3,815	7,053	**399,056**	**43.78**
Trans Texas	17,345	3,879	.....	11,925	7,869	15,240	**405,291**	**35.55**
West Coast	18,246	3,234	**47.87**	4,005	2,082	5,023	**311,329**	**52.14**
HAWAIIAN								
Hawaiian	37,479	5,387	**67.27**	3,931	.....	105,155	**591,223**	**58.51**
Trans Pacific	15,697	1,953	**52.87**	649	.....	8,356	**159,412**	**52.05**
CARGO LINES								
Aerovias Sud Americana	.....	.....	.....	.....	.....	616,322	**616,322**	**66.18**
Flying Tiger	3,159	12,051	**98.06**	23,249	.....	6,435,747	**7,664,120**	**66.51**
Slick*	.....	.....	.....	.....	.....	.....	.....	.....
Riddle*	.....	.....	.....	.....	.....	.....	.....	.....
HELICOPTER								
New York Airways	2,923	55	**56.70**	1,000	1,137	478	**7,685**	**61.06**
Los Angeles Airways*	.....	.....	.....	.....	.....	.....	.....	.....
Helicopter Air Service	.....	.....	.....	2,321	.....	.....	**2,321**	**40.94**
ALASKAN								
Alaska Airlines	3,697	1,517	**26.41**	35,340	.....	508,893	**717,775**	**43.56**
Alaska Coast	2,956	255	**56.42**	3,677	.....	3,534	**33,282**	**62.03**
Byers Airways	171	19	**30.64**	552	.....	1,177	**3,798**	**75.85**
Cordova	1,069	173	**49.71**	2,062	.....	67,968	**87,656**	**79.30**
Ellis Air Lines	4,010	191	**48.35**	1,671	.....	2,529	**23,692**	**59.05**
Northern Consolidated	1,209	404	**47.64**	22,493	209	959,719	**1,026,968**	**93.84**
Pacific Northern	8,162	6,363	**58.68**	62,217	.....	211,018	**961,056**	**66.43**
Reeve Aleutian	327	242	**48.99**	9,761	.....	12,387	**49,286**	**59.34**
Wien Alaska	1,765	853	**15.88**	30,889	.....	871,030	**988,941**	**94.56**

*Not available.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

Boeing cabin mock-up designed for jet-age travel

This life-size mock-up of the Boeing Jet Stratoliner cabin was designed to provide an interior as modern and advanced as the 600-mile-an-hour performance of the aircraft itself.

Ninety-eight standard seats, with 40-inch spacing, are provided, along with lounges forward and aft for 10 extra passengers. The seats, in two- and three-abreast sections, are set in floor tracks. This feature makes possible quick changes of seat spacing, in one-inch stages, and permits four-, five-, and six-abreast seating in any desired combination. A complete changeover requires only an hour.

Because there are twice as many windows in this cabin as in any airplane now flying, there is never a problem of seats out of phase with windows. This arrangement also gives all passengers, even in innermost aisle seats, an unobstructed window view.

Reading-light and forced-air controls, "seat belt" signs, and an individual speaker are located in units suspended from the hat rack. These units, which tend to compartmentalize the cabin, can be snapped out for inspection or repair. They are infinitely adjustable in location to conform to any seating arrangement. All ceiling and wall surfaces are in washable plastic, in panels that can be pulled out, or snapped back, in minutes, greatly speeding up structure inspection and maintenance.

These features — and many, many more — will bring jet-age advantages to both operators and passengers. Eight major American and European airlines have already ordered fleets of Boeing jets: Air France, American Airlines, Braniff International Airways, Continental Air Lines, Lufthansa-German Airlines, Pan American World Airways, Sabena Belgian World Airlines and Trans World Airlines.

This Boeing is the only American jet transport proven by a flight-tested prototype. It benefits, too, from Boeing's unique background of experience in designing, building and flying more large, multi-jet aircraft than any other company in the world.

BOEING

Helicopter Air Service Gets Downtown Permit

Washington—Authority to operate the first scheduled passenger service between an airport and a downtown area has been granted to Helicopter Air Service by the Civil Aeronautics Board.

The helicopter airline will be able to run a shuttle service between Chicago's Midway Airport and O'Hare Field and between the two airports and the downtown Chicago business district under terms of the new seven-year certificate awarded in the Chicago Area Service Case. The line also received exemption authority to operate in the suburban area within a 60 mile radius of Chicago.

When HAS begins carrying passengers, the nation's three largest cities—New York, Chicago and Los Angeles—will have passenger-carrying helicopter lines operating from their major airports.

Helicopter Air Service has said that, if the CAB granted passenger authority, operations between Midway and O'Hare could be started by the end of July, with service to the Loop possible by the end of August (AW April 23, p. 148).

The carrier now operates a fleet of Bell 47G helicopters in a mail service. Plans are under way, however, to re-equip with S-55 and S-58 aircraft for passenger service.

The CAB decided to restrict HAS' new certificate to the triangular route between the airports and the Loop. In its application, the carrier asked for a system of routes through the Chicago suburban area in addition to the downtown route.

Instead of issuing a certificate for the suburban services, the Board gave HAS exemption authority to carry passengers, cargo and mail between any points within a 60-mile radius of O'Hare Field, except that the northern periphery of the radius cannot extend beyond Racine, Wis.

"In view of the experimental nature of the proposed passenger operations, the fluid character of the service to be rendered, the prospective cost to the government, and the need of the carrier for maximum operational flexibility, we believe it is necessary to limit HAS' certificated operations to the inner triangle route," the CAB said.

CAB member Chan Gurney dissented from the majority opinion on the issue of suburban passenger service.

Gurney said the cost to the government will be too high to make the suburban service practical and that HAS would gain sufficient passenger know-how from the triangle route. He pointed out that similar experiments in Los Angeles and New York are already costing the government substantial amounts of money in subsidy support.

To allay the fears of suburban communities that helicopter operations might be suspended at any time under the exemption authority, the Board stipulated that the communities affected will have a chance to present their case before changes are made in HAS' service.

Shortlines

► **National Airlines** reports that its Piggy Bank Vacations to the Miami area are drawing stronger and earlier interest this year, with reservations running 29% ahead of the same period last year.

► **New York Airways** carried a record 3,720 passengers in May. NYA now operates 49 passenger flights a day between the three major New York area air terminals.

► **Southern Airways** plans to start service over its new Atlanta-Panama City route June 29 with two round-trip flights a day via Columbus, Ga., and Dothan, Ala.

► **Trans World Airlines** has completed installation of weather radar in its fleet of Super-G Constellations . . . TWA's passenger traffic last month was 12% above that for May, 1955 . . . TWA will start picking up its own interline baggage at Chicago's Midway Airport instead of waiting for connecting airlines to deliver it. The carrier also has installed a self-claim baggage counter to speed baggage delivery at Midway.

CAB Orders

(May 31-June 6)

GRANTED:

Japan Air Lines authority to operate four round-trip flights between San Francisco and Sao Paulo, Brazil, provided no traffic is carried between Wake Island, Honolulu or San Francisco and South American points except through traffic between Tokyo and South American points. The authority terminates April 15, 1957.

Flying Tiger Line an exemption to operate a charter flight from New York pursuant to a contract with American Youth Hostels, Inc.

Permission to Intervene in the Seven States Area Investigation to the City of Norfolk, Neb., the Aviation Committee of the Norfolk Chamber of Commerce and the City of Grand Island, Neb. **Flying Tiger Line** an exemption to perform a transatlantic charter flight for Sherwood Eddy Seminar. The Board reconsidered its earlier refusal to grant the exemption.

Paul D. Choquette, doing business as Inlet Airways, an exemption as an Alaskan pilot-owner to hire pilots and use PBY or Grumman Goose aircraft between May 1 and Oct. 31 of each year so long as the aircraft are not operated on routes served by a scheduled Alaskan carrier. Choquette's application for scheduled service between Seldovia, Homer, Ninilchik, Kasilof, Kenai and Anchorage was consolidated into the Intra-Alaska Route Investigation Case.

Flying Tiger Line an exemption to perform three charter flights for Saenger Chor Newark, Inc., and Bremervoerder Manner Und Damen Chor. The Board reconsidered its earlier refusal to grant the exemption.

Flying Tiger Line Los Angeles Air Service and Slick Airways exemptions to operate a total of 46 charter flights from London, Paris, Brussels, Berlin, Bremen, Hamburg, Munich, Linz, Rome and Athens to New York pursuant to contracts with the Intergovernmental Committee for European Migration.

Permission to intervene in the Florida-Texas Service Case to the Lake Charles, La., Association of Commerce; the Baton Rouge, La., Chamber of Commerce, and the Lafayette, La., Chamber of Commerce.

Department of Defense permission to intervene in the Intra-Alaska Route Investigation.

Port of New York Authority permission to intervene in the Puerto Rico Service Case.

State Aviation Board of Ohio permission to intervene in the City of Portsmouth Service Investigation.

Riddle Airlines an exemption to carry personnel accompanying shipments made for the U. S. Government or government contractors, provided any person carried is charged 200% of the applicable general commodity rate computed on the basis of the passenger and his luggage and provided such personnel are carried only when accompanying a shipment.

APPROVED:

Agreements involving Pan American World Airways, British Overseas Airways Corp. and various other carriers relating to inter-carrier arrangements.

ORDERED:

Suspension and investigation of an increase in charges for excess valuation and in collection and remittance charges filed by the Railway Express Agency.

New York Airways to show cause why the Board should not set temporary mail rates of $1,323,135 annually beginning Feb. 3, 1956.

British Overseas Airways Corp. authority to serve Detroit through Willow Run Airport amended to remove a 60 day time limit.

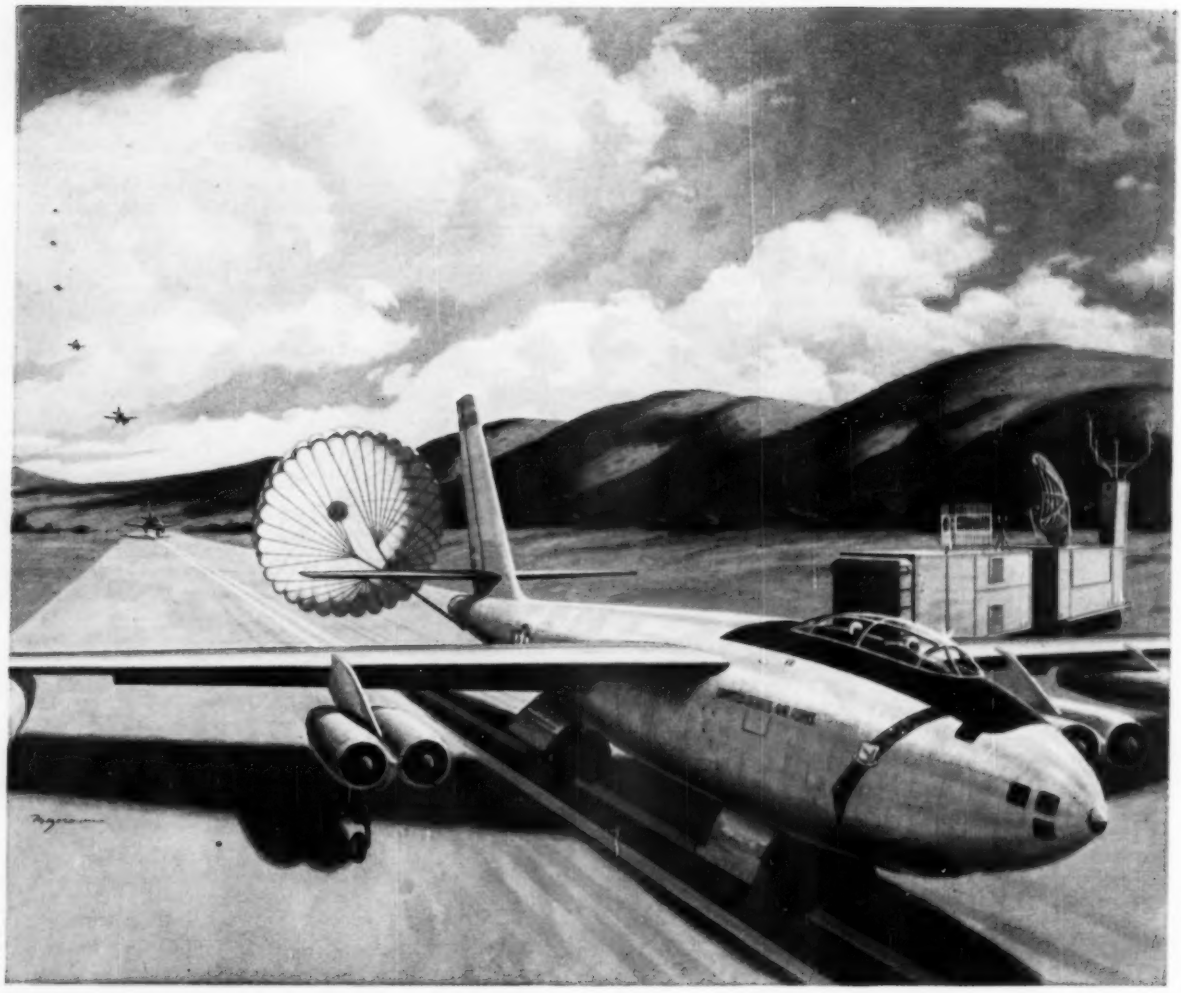
Bermuda classified as a Class B station for purposes of the multi-element service mail rate formula, effective June 1, 1956.

Bonanza Air Lines final mail rate set at the rate proposed by the Board in its show cause order for the period April 25, 1955, to Jan. 31, 1956, and the period starting Feb. 1, 1956.

DENIED:

Inlet Airways motion to consolidate its application for a certificate between Seldovia and Anchorage, Alaska, with the Intra-Alaska Route Investigation.

Petition of Allegheny Airlines and 12 other local airlines for reconsideration of earlier CAB refusal to allow the carriers to intervene in the Large Irregular Case. The local airlines will be allowed to participate in the case as amicus curiae to the extent of filing briefs and presenting oral argument.



Gilfillan announces

AUTOMATIC GCA

first fail-safe, proven system—now in production

ONLY AUTOMATIC GCA PROVIDES

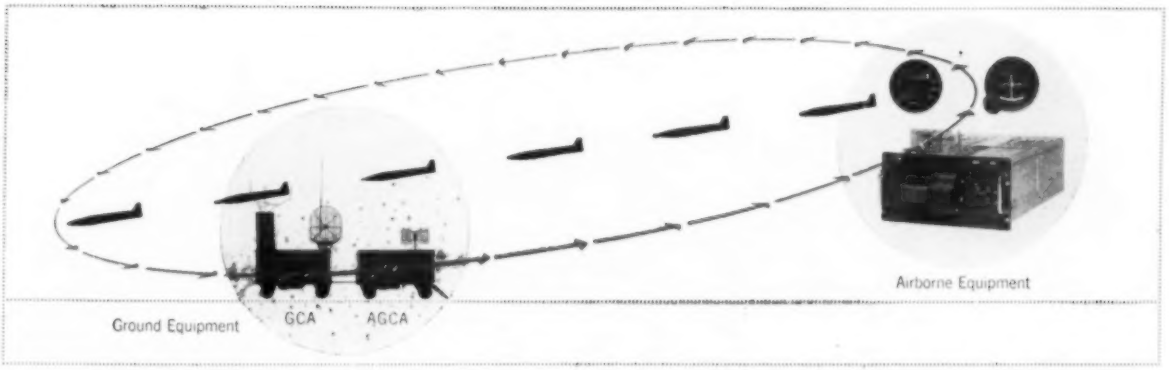
FAIL-SAFE | High density final Approach
Closed loop protection
Automatic overtake warning

Automatic Ground Control Approach is an accessory to a basic GCA Radar system, and is capable of handling six aircraft on final approach at 30-second intervals; or at a landing rate of 120 aircraft per hour in a continuous stream.

AGCA consists of a basic GCA Radar equipment, and a six tracking channel computer and coder on the field. It utilizes standard USAF and US Navy airborne telemetering equipment to feed the traffic control data directly to the aircraft autopilot and airborne instruments.

AGCA replaces six GCA operators, and relieves the pilot of the manual chore of making right-left and up-down aircraft corrections during final approach to the runway.

CONTINUOUS AIRBORNE DATA Automatic GCA also provides the pilot with continuous azimuth and elevation position information on an airborne crosspointer meter and continuous distance from touchdown information on an airborne DME-type indicator. This airborne data enables the pilot to monitor the Automatic Ground Controlled Approach, or to fly the approach manually.



Automatic GCA plugs into present basic GCA Radar system, transmits control data to standard USAF and US Navy airborne telemetering equipment, which activates autopilot to bring aircraft down correct approach path automatically.

ALL THREE TYPES OF CONTROL AGCA therefore provides three types of control for all types of aircraft in the same stream of landing traffic:

1. Complete Automatic GCA control OR
2. Complete data to pilot for manual approach OR
3. Regular GCA talkdown.

RADC/GILFILLAN DEVELOPMENT AGCA is now in production after nine years of joint research and development work by the laboratories of the USAF's Rome Air Development Center and Gilfillan.

AGCA has been thoroughly flight-checked with several thousand actual controlled approaches of all types of piston and jet aircraft.

Safety features of AGCA include: continuous closed loop protection, eliminating the serious time lapse of open loop systems; automatic overtake warning; automatic warning of excessive azimuth and elevation error; automatic monitor of all approaches; instant simplified override features; continuous semi-private line communication with each aircraft; automatic warning of any malfunction of all ground and airborne electronic and mechanical equipment, and automatic self-alignment of the electronic system.

SIMPLIFIED MAINTENANCE SYSTEM AGCA features unitized construction of both ground and airborne equipment and simplified maintenance.

AGCA is fully compatible with both existing and future navigational systems, including those currently in design and development.

Gilfillan offers engineering specialists challenging opportunities in all fields of complete Systems Research and Development under Prime Contracts with all military services for Automatic Navigational Aids, Missile Guidance Systems and Electronic Countermeasures. Contact R. E. Bell, Gilfillan, 1815 Venice Blvd., Los Angeles, California.

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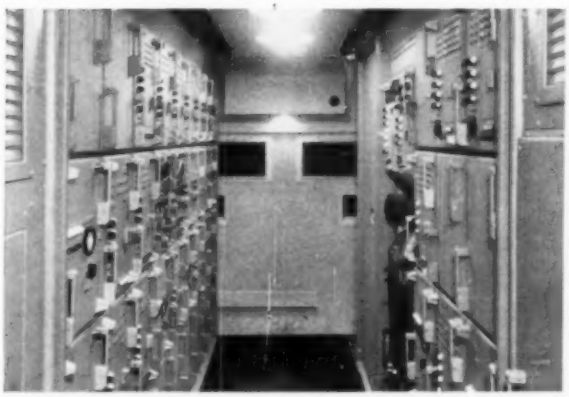

INTERIOR OF AGCA TRAILER: Six tracking channels at left handle six aircraft at 30 second intervals or at a landing rate of 120 aircraft per hour. Radar Monitor Scope on right side presents continuous aircraft position data enabling operator to monitor all approaches.

MONITOR CONTROL BOARD: Operator, with constant data on the radar scope and indicator, can monitor all automatic approaches; or, with "pushbutton" communication, switch to a standard GCA talkdown for an individual manual approach.

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* DuPont trademark for its Tetrafluoroethylene resin.

hose assemblies to meet your stringent requirements!

Now, The Weatherhead Company, maker of precision parts for aircraft, offers flexible hose with inner core of famed DuPont Teflon, and protective cover of stainless steel wire braid. Weatherhead hose ends are of superior design and more than a match for Teflon in enduring protection against blowoffs and leakage at elevated temperatures and high pressures. Besides, they offer space and weight saving advantages so vital in present and future designs. Next time you have a Teflon application, specify only Weatherhead hose assemblies and be sure of these

MAJOR ADVANTAGES

- Operation at high pressures, in extreme temperature range (—100°F to +500°F).
- Chemical inertness to practically all fluids within the above temperature range.
- Indefinite shelf life.
- Available in sizes —4 to —20.
- Freedom from line contamination as result of loose particles on inner liner.
- Minimum bend radii, with less restriction of inside diameter.
- Tested to conditions in excess of MIL-H-5511 requirements and those of airframe and engine manufacturers.

- COMPRESSORS
- TITANIUM PRODUCTS
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- PRECISION ALUMINUM, BRASS, STEEL FORGINGS
- HOSE AND HOSE ENDS; HOSE ASSEMBLIES
- MS (ER)* FLARELESS TUBE FITTINGS
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Aviation Division

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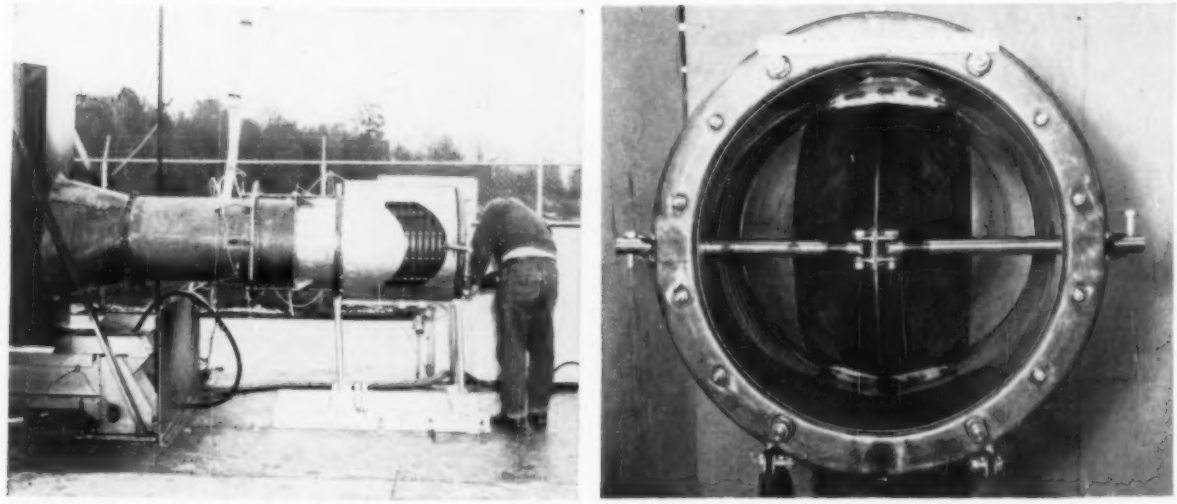


GOODYEAR'S OUTDOOR REVERSE thrust stand. The screen protects the J47 engine from reverse flow. Rear view of reverser shows a partial blockage door extended into the stream. At an increase of 4.5 basic engine weight this reverser gives 45% reversed thrust.

Goodyear Reverser Chops Jet Landings

By Robert Cushman

After a three-year Air Force sponsored development program, Goodyear Aircraft Corp. believes it has a reverser which can chop the landing run of jet aircraft in half—with minimum effect on other phases of performance.

Goodyear has been working on both cascade and target type reversers. Though their target type may have more immediate popularity because it better satisfies the needs of the century series fighters, the internal tail-pipe cascade reverser represents an important step in thrust reverser progress. The design principle involved may provide the answer to squeezing jet transports onto existing runways. Also this "engine accessory" may open up new possibilities for low speed control and deflected engine thrust for direct lift in STOL/VTOL aircraft.

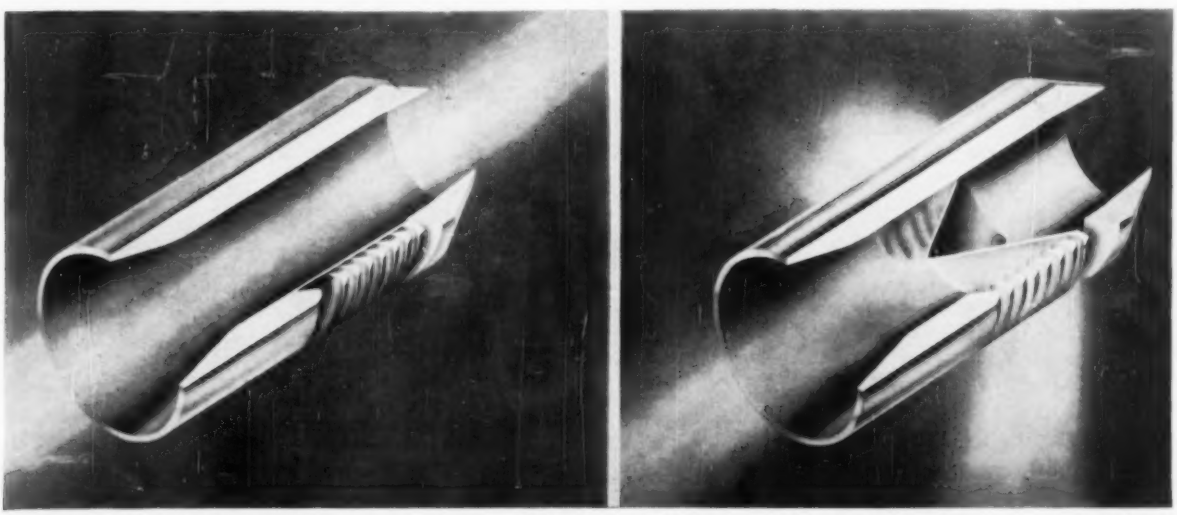
It is the only type of reverser that is compatible with jet silencers, Goodyear says.

In operation, two duck-bill shaped doors swing in from the tailpipe sidewalls to block the engine exhaust while they uncover the reverse flow openings. A cascade of turning vanes in each opening bends the re-directed exhaust forward for reverse effect. In normal forward flight the openings are covered by the doors, which then act as sections of the sidewalls.

Modified Reverser

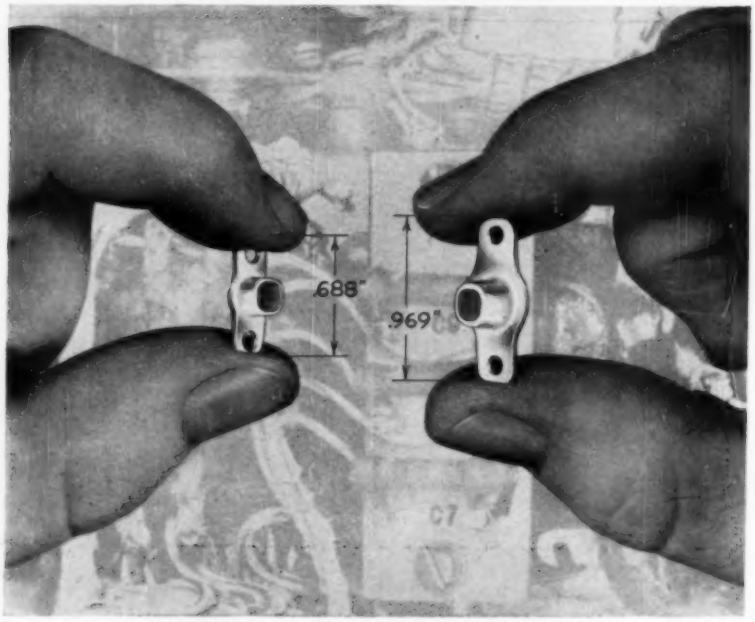
As cascade turning of the flow can be an efficient process aerodynamically, high percentages of reverse thrust are obtainable.

Goodyear engineers have measured up to 91% thrust reversal with a mechanism that only adds 6.7% to the basic engine weight. A modified reverser which uses a smaller door and is only capable of partial flow blockage can



ARTIST'S DRAWING OF REVERSER cutaway showing normal thru-flow and then reverser taking hold. Blocking vanes are retracted into sidewalls for full forward thrust and swung out into stream for reverse thrust.

FASTENER PROBLEM



New LHTA1M nut on left, standard anchor nut on right.

"SPACE-SAVER" anchor nuts needed for avionic applications

Shrinking space allowables and the urgency of eliminating every possible pound of weight, are problems that continuously confront electronic and avionic design engineers. The "black boxes" for radio, radar and missile guidance systems are under constant scrutiny for miniaturization . . . and fasteners too, are affected. One of the most urgent needs was for a tiny "fixed" anchor nut for attachment of interior components. Lowest possible weight and size were required; the ability to withstand temperatures in the area of 500° F. was desirable.

Type LHTA1M is ESNA's answer. Over-all length of .688" compares to .969" for a standard 10-32 size AN366 locknut. Weight is only .17 lbs. per 100 pieces compared to .81 lbs. These space saving "fixed" nuts meet the same tensile and vibration requirements as the standard sized nut and will withstand temperatures up to 550° F. Like all self-locking Elastic Stop® nuts they are dependably self-locking and are guaranteed for extended re-use. Sizes 4-40 thru ¼-28 steel, cadmium plated. Space-savers are also available in one-lug and corner-mounting anchor nut shapes.

MAIL COUPON FOR DESIGN INFORMATION

ESNA

Elastic Stop Nut Corporation of America, Dept. N1-625
2330 Vauxhall Road, Union, New Jersey

Please send me the following free fastening information:

☐ Bulletin on Miniature Anchor Nut.

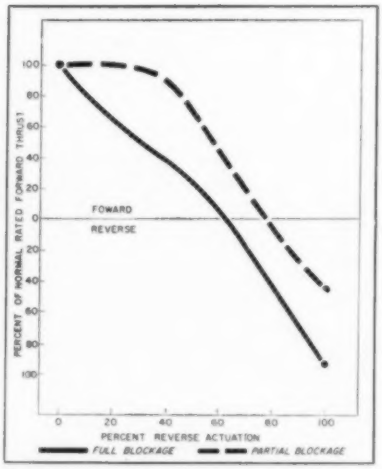
☐ Here is a drawing of our product. What self-locking fastener would you suggest?

Name_____ Title_____

Firm_____

Street_____

City_____ Zone____ State_____



CURVE OF GRAPH shows amount of thrust related to angle of door opening. The full blocking door's reverse effect is nearly linear but the partial blocking door has a delayed effect.

achieve up to 45% reversal with 4.5% weight penalty.

The reverser has been engineered to allow the pilot to come in at full throttle, using his reverse in partial actuation as a "thrust spoiler" to kill the engine's forward thrust so that if he is waved off, he can instantly regain full power.

Lag Disastrous

The time difference between almost instantaneous resumption of full thrust with a reverser (less than one second as the gases help force the reversing mechanism out of the way) and the 7-15 second wait for a jet engine to come up to full power from idle rpm. can prove disastrous.

Current Air Force opinion is that this quality of immediate resumption of power is mandatory. Some commercial transport designers, on the other hand, feel that it is enough to wait until the plane has touched down after idling in and then re-accelerate the engine and throw the reverser in—in much the same manner in which piston-engined planes now use reverse propeller pitch.

New Control Means

Goodyear plans to incorporate differential actuation into the two doors so that side thrust may be used to provide extra yaw control at low speeds. Though they are thinking in terms of ground taxi, the inherent possibilities for flight control forces and even direct lift for STOL craft suggest future directions for the development of this type of reverser. The linear response to control actuation shown by the curves (see graph above) is desirable. The steady, even modulation of thrust from full forward to nearly full reverse indicated by the curve for full blockage shows

that this design has much more than just "off-on" capabilities.

Compatibility with the engine is very important—especially on this type of reverser which cuts into the tailpipe.

Flow Unrestricted

Goodyear has found that it is possible to match the reverser flow to the engine characteristics so that the flow is not restricted when the reverser is put into operation. (NACA Technical Note 3665 warns that flow restriction by a reverser causes compressor stall and turbine overtemperature.)

Like other competing reverser types, targets and external ring cascades, the internal tail-pipe cascade is fail-safe. If anything goes wrong, for example if the actuating mechanism won't work, the exhaust gases force the blocking doors out of the way and nearly normal forward thrust is resumed.

This is what the Air Force means by fail-safe.

Transport operators who do not plan to use reverse until after they are on the ground may want the opposite sort of fail-safe: the doors pivoted so they will remain open if anything goes wrong.

One Shortcoming

But because of flow leakage around the doors when closed, about 1% of engine thrust is lost. However, General Electric, which at one time was interested in a cruder variety of this concept for a thrust spoiler, has developed an inflatable seal which will withstand temperatures. Goodyear is confident that it can lick the problem.

Another problem, which may be either a virtue or a shortcoming, depending upon how you look at it, is what happens to the noise when this reverser is used. Since the internal cascade reverser is upstream of the jet nozzle, it will not interfere with the silencer upon take-off.

However, on landing the flow is blocked from passing through the silencer. Just how loud the reversed flow will be is not known, but Goodyear hopes to do extensive sound level evaluations when and if the Air Force approves a flight test program.

Not for Fighters

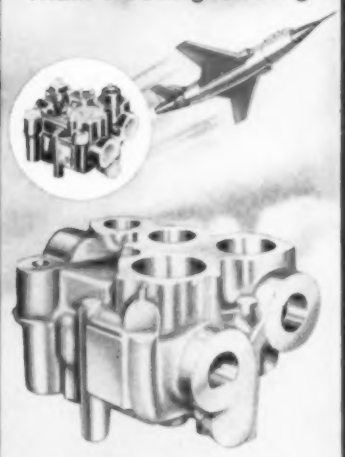
As with any Air Force contract, timing has played a part in the Goodyear internal cascade reverser's history. The F86 program for which the reverser shown in the photographs was originally intended is being phased out of use before the reverser has had a chance to be proven out in flight.

Furthermore, as fighters need only 50% reversal and cannot tolerate either the slight thrust loss or the increased volume at their rear ends (where afterburners already have made them over-

Bomb Bay Capsule for B-52

Expanded strategic roles for Boeing B-52B and B-52C are possible through incorporation of bomb bay capsule, being placed under bomb bay. Pressurized, air-conditioned capsule has stations for two-man crew, provisions for four aerial cameras, interchangeable electronics equipment, antennas. Design allows B-52 models to be utilized for conventional and nuclear weapons delivery, photographic reconnaissance and electronics missions. B-52D is strictly a long-range bomber, with no multi-purpose capabilities.

Chandler-Evans depends on **HAMPDEN BRASS** for Main Housing Casting



The Engineers and Facilities of HAMPDEN BRASS were called upon by Chandler-Evans to help develop and cast this main housing.

The sand casting process was chosen because the intricate cores could be cast at lower cost while still maintaining high quality standards. Hampden Brass is proud to produce the main housing casting for Chandler-Evans's RC-9 Afterburner Control used on turbojet engines.

Your casting problems may be solved just as effectively through the use of Hampden Brass premium quality castings . . . by the sand, permanent mold or die casting methods. Our more than 50 years' know-how is your assurance of the best casting techniques to help reduce costs and improve performance.

Avail yourself of our engineering counsel . . . or write for a casting quotation today!

Send for brochure, "Behind the Scenes" . . . complete digest of Hampden Brass's experience, equipment and facilities.

HB

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AND ALUMINUM CO.
Established 1903
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Producers of Sand, Permanent Mold, Die & Fiberglas Castings

Official U. S. Navy Photograph

The U. S. S. Boston (CAG-1), the Navy's first guided missile cruiser, with Terrier Missiles and their launchers at the stern.

NAVY BUREAU OF ORDNANCE DEVELOPS WEAPON SYSTEMS FOR USE AGAINST ATTACK BY SEA OR AIR

The recent unveiling of the Navy's first ready-for-combat anti-aircraft guided missile weapon system —TERRIER—is but one result of the research and development work being done by the U. S. Navy's Bureau of Ordnance and a coordinated team of industrial and educational institutions.

From its establishment in 1842, the Bureau of Ordnance has provided the weapons with which the Navy has fought victoriously in six wars. With the evolution of armament, from the first muzzle loading cannons to today's complex weapons systems, it has directed the design, development, and production of the computers, fire control, and other types of equipment comprising the Navy's air, surface, and underwater ordnance.

The Research and Development Division of the Bureau of Ordnance has the responsibility of initiating and coordinating the research and development of the many projects which result in such end products as guided missiles, homing torpedoes, aircraft laid mines, and the launching and control systems for these weapons.

The job of guiding a key element of a modern day weapon system from the idea stage to the ready-for-combat stage involves a wealth of technology—drawing upon the skill, farsightedness, and courage of responsible scientific and technical personnel in the Bureau of Ordnance and its laboratories, and their counterparts in universities and industrial organizations.

This is one of a series of ads on the technical activities of the Department of Defense.

103

FORD INSTRUMENT COMPANY

DIVISION OF SPERRY RAND CORPORATION

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Ford Instrument Company engineer placing equipment designed for Navy instrument in one of the environmental test chambers.

ENGINEERS

of unusual abilities can find a future at FORD INSTRUMENT COMPANY. Write for information.

sized) Air Force preference has definitely swung away from internal cascade reversers to external target types, says Lt. Charles Hoelzer, a reverser authority in the Power Plant Laboratory at Wright Field.

It now remains to be seen if other types of aircraft, especially transports, which may not mind the slight thrust loss and need a reverser which will blend with their indispensable silencers, will take to this new variation on a very urgent theme.

Lockheed Georgia Division Takes Over Florida Office

Georgia Division of Lockheed Aircraft is taking over the aircraft engineering office which Fairchild Engine and Airplane Corp. has just closed in St. Augustine, Fla. Lockheed had been considering opening an office in Florida and Fairchild's closing offered an opportunity to acquire engineers. Most of the 33 engineers employed by Fairchild have accepted Lockheed offers.

Czechs "Kill" One Balloon

This page reproduced from a Czech magazine is a small part of the balloon-spying propaganda campaign conducted recently by the Communists. The story tells how the balloon was sighted and shot down by officer Novak (happily reporting, "Tasks carried out!" in the lower right picture). The Czech article says the balloons weigh about 1,200 lb. and threaten the safety of the air lanes. They also carry "inflammatory pamphlets", automatic cameras, transmitters, a receiver, and other "equipment . . . serving their spying purposes." The plane appears to be a standard two-seater trainer UMiG-15. The balloon photos, supposedly from a gunsight camera, lack a certain degree of authenticity. According to the article, the balloon jumped and pitched in the air, an unusual phenomenon not generally associated with free balloons.

★ Removed with only a 35° turn
★ Weighs only .43 lbs.
★ Opens safely under pressure
★ Full 3-inch opening
★ Lever action design

The first tank filler cap to successfully pass all test requirements of MIL-C-7244B (ASG) applicable to fuel, oil, alcohol-water and hydraulic reservoirs. Write for data sheet on this new FC-3500 flush mounted cap.

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CLINE ELECTRIC

● Giant aircraft of the U. S. Air Force as well as ships and planes of the U. S. Navy owe much of their superior performance to electronic controls and ordnance equipment by Cline Electric Manufacturing Company of Chicago . . .

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to power their
Douglas DC-8 airliners

ROLLS-ROYCE AERO ENGINES LEAD THE WORLD

Honeywell Sets Up West Coast R & D

By Irving Stone

Los Angeles—An engineering group has been established here by Minneapolis-Honeywell Regulator Co.'s Aeronautical Division to extend the firm's research and development services to the West Coast.

Known as the Los Angeles Engineering Section, the group was set up last July for close proximity to the concentration of aircraft builders in this area.

Philosophy behind the move was to create close liaison between Honeywell and West Coast customers in the development of flight control equipment for aircraft and missiles.

While it operates as an entity, the Los Angeles Engineering Section is backed by the extensive resources of the parent organization in Minneapolis. This allows the Los Angeles group to call on the parent division to furnish special parts or equipment, which it may have on hand, for incorporation in new systems under development for West Coast companies.

The Los Angeles group initially started with a force of about 25 engineers and technicians transferred from Dallas, Tex., where it had completed an extensive development project for a flight control system on the Chance Vought Regulus missile.

In less than a year, this force has grown to 125 persons, 40 of whom are professional engineers. Plans are to expand this force to 200 people. Projections beyond a staff of this size have not yet been formulated. The theory is to keep the staff small so it can retain the extreme flexibility considered essential in initial development work.

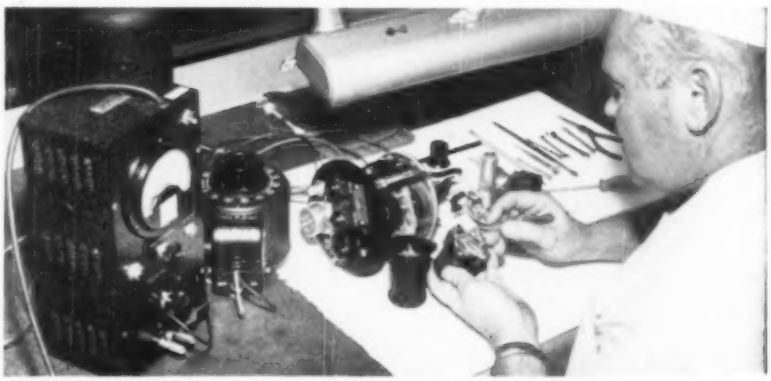
Under the guidance of manager John V. Sigford, Honeywell's Los Angeles branch has completed more than $1 million worth of engineering business on the West Coast, and the backlog far exceeds this figure.

One of the group's foremost accomplishments has been the development of flight control systems for a missile and target drone built by Radioplane. The control system for the missile already has been flight tested successfully, while the drone is scheduled for flight in the near future.

An unusual feature of the missile flight control system is an electromechanical computer which eliminates the need for the conventional coordinate converter (gyro platform type of computer). Advantages of the installation include reduced size, automatic orientation, more rugged construction and simpler maintenance.

Flight control system for the Radioplane drone, while comprised of conventional, proven components, has been developed into a compact package not exceeding 1 cu. ft. in volume.

AUTOPILOT DEVELOPED by Honeywell's Los Angeles Engineering Section for supersonic drone is removed from altitude chamber following environmental tests.



ALTITUDE CONTROLLER unit of flight control system for supersonic drone is assembled in Honeywell's Los Angeles engineering facility.

The group also is developing an attitude indicator for Hughes Aircraft based on a Hughes concept of presentation of attitude information to the pilot. Prototype model of the indicator is scheduled for evaluation late this year.

Another project under development is a stability augmentation system (pitch and yaw damper) for an advanced version of Convair's F-102.

Considerable research is being directed toward the development of flight control systems to be operated under temperatures in the vicinity of 300F. Scheme employed is that of improving transfer of heat by a miniature heat exchanger contained in the electronics package.

This system development is directed toward aircraft and missiles scheduled to enter the operational field in the near future.

Bulk of the parts for prototype flight control systems are fabricated in a precision machine shop operated in conjunction with the Los Angeles group's research facilities.

Also located on premises is an environmental testing facility, including equipment for extremes of temperature, altitude and vibration.

Teflon Flexible Hose Manufacturers Growing

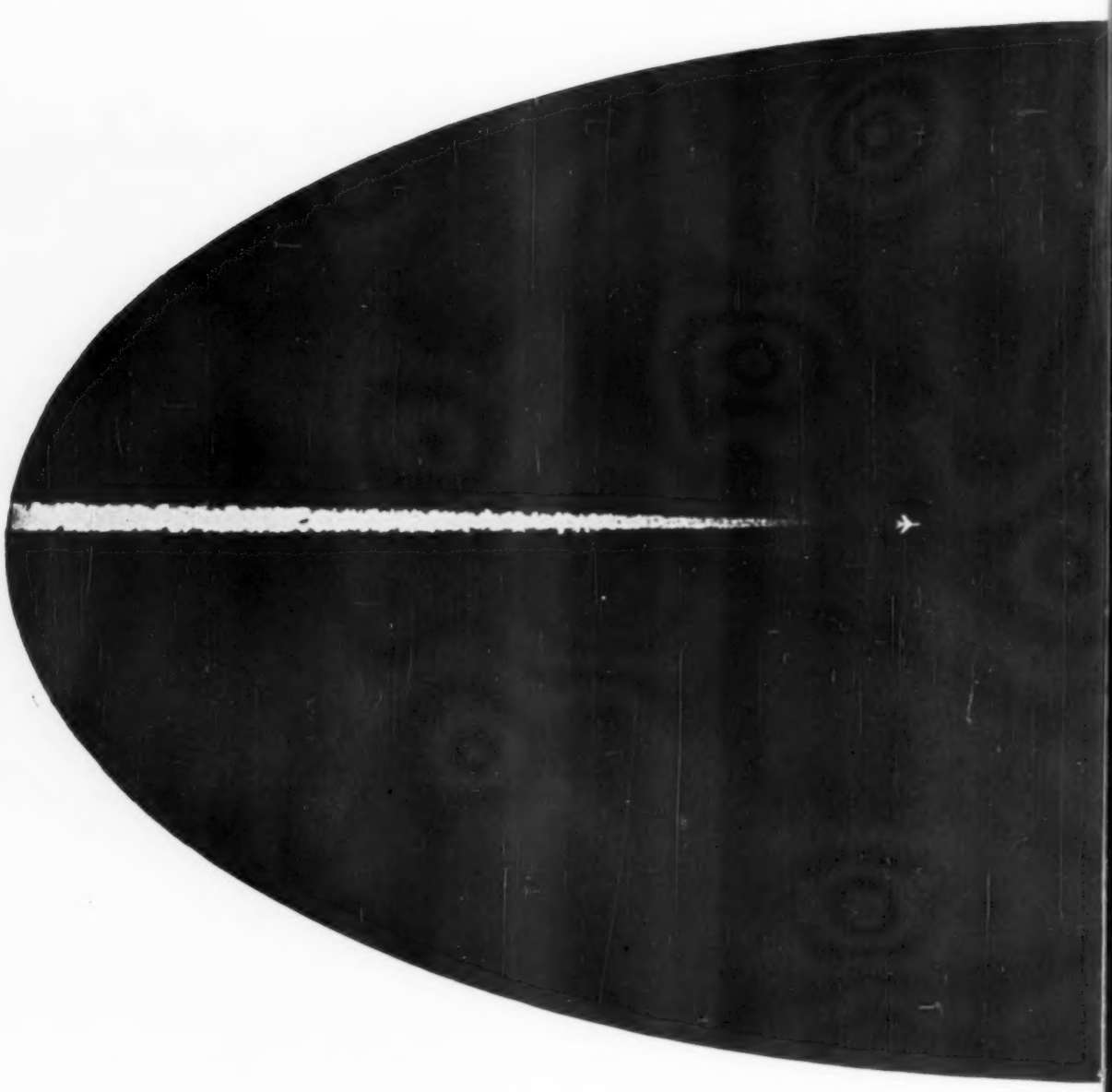
The growing popularity of teflon hose for aircraft, rocket and missile applications—because of its resistance to very high and low temperatures and imperviousness to chemical attack—is underlined by the growing number of teflon hose suppliers.

Two newcomers to the field:

- **B. F. Goodrich** Industrial Products Co., which will make the hose under a license agreement with Resistoflex Corporation (AW March 1, 1954, p. 48). Resistoflex will continue to manufacture and market the hose.
- **The Weatherhead Co.** of Cleveland, Ohio, which has started making teflon hose in sizes from −4 to −20.

Aeroquip Corp. of Jackson, Mich. has long been a supplier of teflon aircraft hose (AW June 7, 1954, p. 75).

NORTH AMERICAN HAS BUILT MORE AIRPLANES



BEYOND SOUND TODAY

A special 40-inch lens camera took this photograph of North American's F-100C SUPER SABRE as it streaked to the world's first official supersonic speed record. The F-100—produced in quantity and on schedule—is the backbone of the U.S. Air Force's operational supersonic squadrons, both here and abroad. Latest F-100 development is the "D", first and only supersonic fighter-bomber in production. The F-100 series, following the famous F-86s, is another example of North American's continuous development and on-time production of effective airplanes for our nation's defense.

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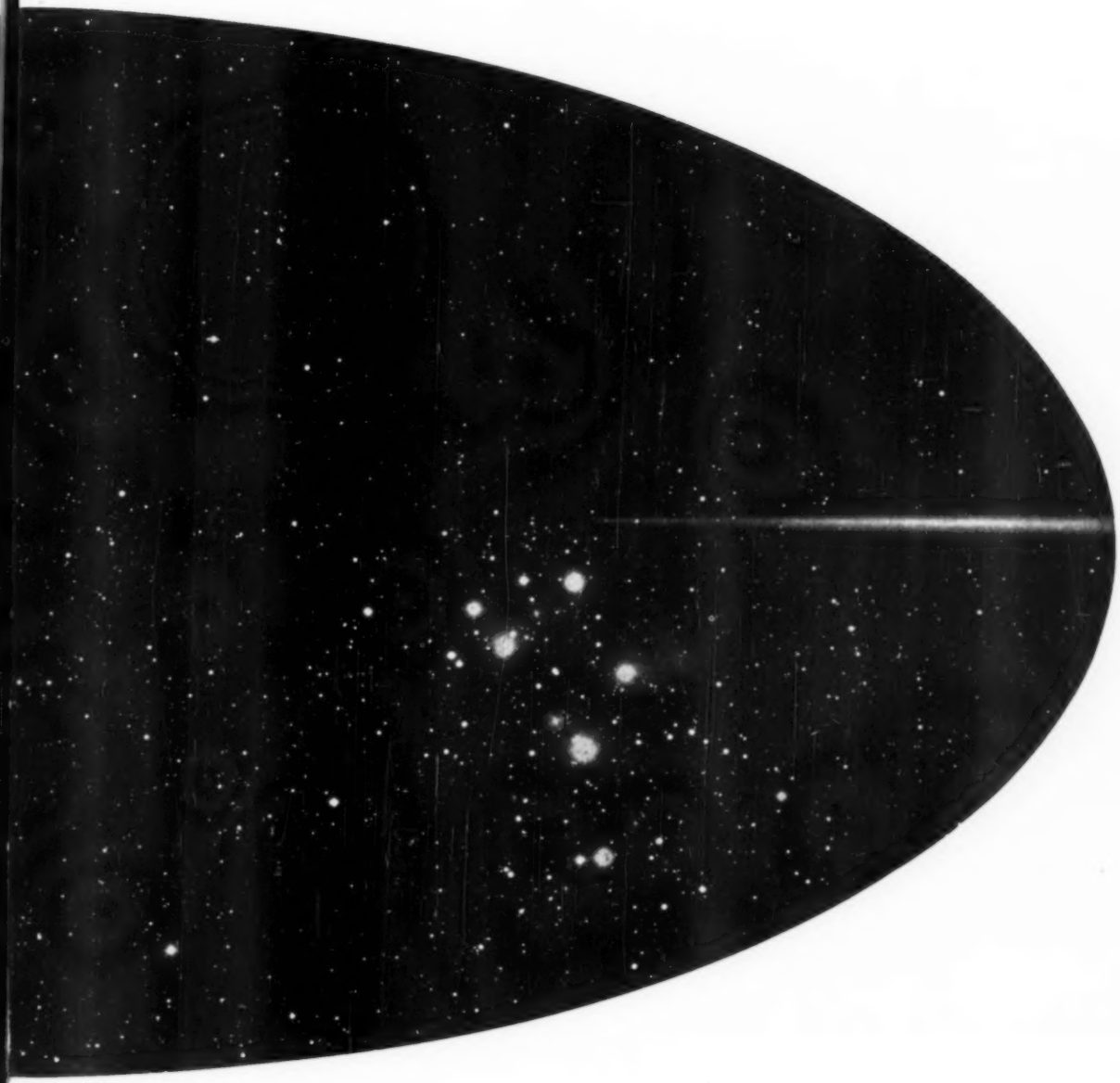

BEYOND SIGHT

TOMORROW

Side by side with North American's continuous development of improved supersonic manned aircraft is the work on an equally vital project—complete weapons system responsibility for the U.S. Air Force SM-64 NAVAHO Intercontinental Guided Missile. This automatically controlled and guided "bird" will be driven by a high-thrust rocket engine, and will fly higher and faster than man can see with the naked eye. The Air Force NAVAHO project is a major factor in our country's program of developing long-range missiles.

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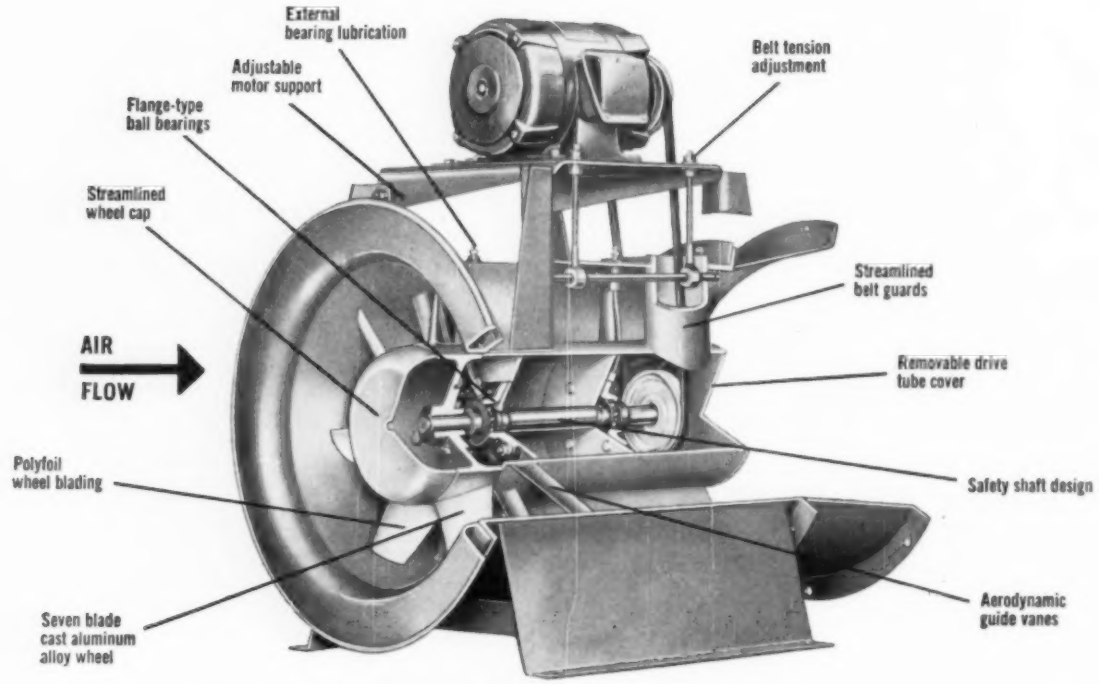

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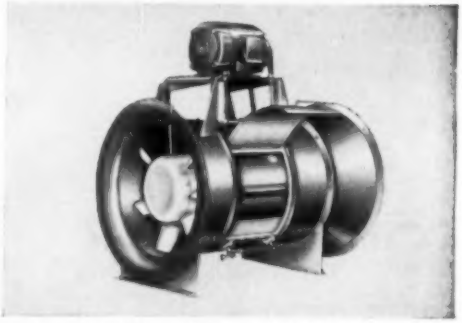

Spray booth Vaneaxial Fan specially designed to provide easy access required for paint spray exhaust!

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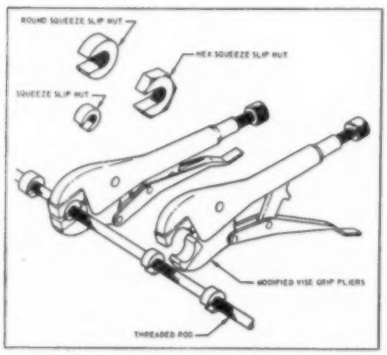
PRODUCTION BRIEFING

Vickers-Armstrong (Aircraft) is moving its Supermarine works to its main factory, South Marston, Wiltshire. This is part of a plan to make the headquarters at South Marston one of Britain's finest integrated units for aircraft design, research, and manufacture.

Robinson Wire Twisters have a new home. Equipped to turn out 50,000 tools per year, the plant is located on a 2½-acre site at 2516 Crosby Way, North Sacramento, Calif.

Kellett Aircraft Corporation is building a new plant on Easton Road, Hallowell township, Horsham, Pa.

Time-saving slip-squeeze which can be slipped into position on the mold or mockup rod and squeezed tight by special pliers, in one operation has been



developed by Convair for use in conjunction with plaster models and mockups. The nuts hold the metal station templates while the plaster is being sculptured in.

Navaho missile power system contract, said to be in the multi-million dollar bracket, has gone to Walter Kidde and Company, Belleville, N. J.

Meyercord Co. has bought the Aircraft Marking Company, Burbank, Calif. The Burbank company now will be known as the Aircraft Marking Components Division of Meyercord.

Albany Products Company, Connecticut Ave., South Norwalk, Conn., a new firm, says that it has been formed to provide industry with fasteners in stainless steel, Monel, titanium and the super alloys.

Sikorsky Aircraft Executive offices have been transferred from Bridgeport to Sikorsky's new plant in Stratford, Conn.

United States Radium Corporation N. Y. C. has contracted to take over

Valve Talk

FOR WM. R. WHITTAKER CO., LTD.

BY MARVIN MILES

The dog-eat-dog battle for engineers within the industry has reached alarming proportions, a battle fought against the background of a fixed engineering manpower pool.

Nor does the vicious circle of pirating do the industry a whit of good. Sure, one company gains a small advantage when it hires a man away from another concern, but it leaves a vacancy that can only be filled when the second company lures an engineer away from a third plant.

The basic problem – the crying need for more engineers—is now recognized, but the industry is pursuing hit-and-miss solutions with one eye fixed fearfully on the astonishing growth of Russian technical capability.

Studies have been made, apprentice training organized, college and high school youths contacted, but the efforts so far have been ineffectual—sporadic and thin-spread – and the continuing, feverish attempts to capture rival plant personnel show in the "battle lineups" carried in the want-ad sections of the daily newspapers.

Engineer executives who face the problem squarely deplore the piracy, but declare that until the industry as a whole takes on the problem with a hard-hitting campaign, there's little else they can do.

"We have a fixed manpower pool in engineering," explains Ed Schmued, Northrop's engineering vice-president. "Those who come into engineering are just about balanced by those who leave it. Yet the problems we face in this jet-and-missile age are piling higher and higher every day."

Schmued, and other future-seeing executives like him, know well the growing technical menace posed by Russia. They know the Soviet "whip-and-candy" policy that forces designated young men to become engineers, a policy of high honor and monetary reward for success and down-the-drain fate for failure.

Cold statistics show that America's peak output of engineering graduates came in 1950 (swelled, of course, by GI students) when 50,000 young men entered the field. Since then the figure has slipped to roughly 20,000 per year. On the other hand the Soviet graduate total has jumped from 28,000 graduates in 1950 to 54,000 in 1955.

Some argue that although Russia has an elite corps of technical experts second to none, the Soviet system is perched on a shaky engineering base in that the USSR staffers have not yet acquired that degree of "engineering feeling" which only broad familiarity with machinery can bring – that they work by the book and require detailed direction.

But an analysis of Russian technical achievements since the end of World War II would seem to prove that the Red system, for whatever reason, is a decided success.

The consensus is that we are still ahead of Russia, but how long we can stay ahead without a boom in engineering is anyone's guess.

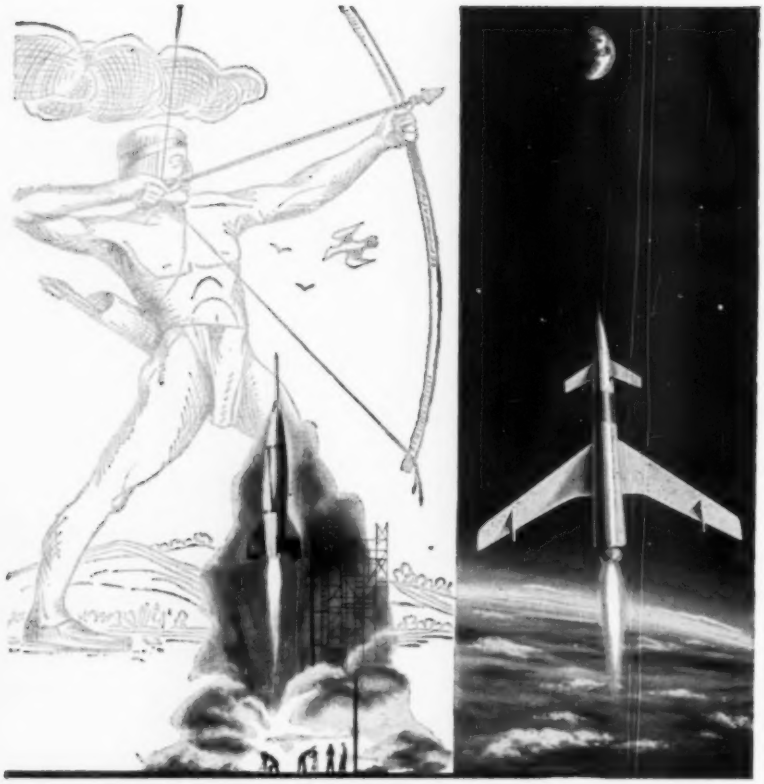
The answer apparently lies in several programs embracing a concerted effort by the industry to improve our educational system and to make more efficient use of the engineers we now have. It's certain that the merits of engineering, its honors and accomplishments must be impressed not only on students, but on parents of grade-school-level youngsters as well.

Here I should like to suggest that the dull, routine teaching of math be given serious study. In many instances a pupil is either frightened or bored with figures as taught today. Certainly, with proper presentation, the subject could be made intriguing, thus laying a firm groundwork for higher math and engineering success.

The program must not only point up the vast possibilities of engineering, with executive positions just a half-step away for experienced men, it must make home extension courses available to upgrade engineers now working. It must create better working conditions and urge better salaries, salaries commensurate with other professional levels. It must work to provide these men with full opportunity to use their skills and their aptitudes and assure honors for accomplishment.

Whittaker, essentially an engineering firm, recognizes the era of the engineer, an era that is here to stay, keynote in the vast, expanding challenge of speed and space. The valve company – as some do and others must – appreciates the vital role of engineering in the world of today and tomorrow. And it treats its engineers with the respect and the consideration they so well deserve.

(Advertisement)



One of a series depicting missiles "Yesterday, Today and Tomorrow"

# of men, missions and missiles...

The ancients' bow and arrow, today's guided missile, and tomorrow's space ship have one thing in common. They are all guided missiles. The problems of aerodynamics, guidance and propulsion remain basic. Early man solved his problem with raw materials and native ingenuity. Now the problems are much more complex, requiring the best our civilization can produce. Today, such problems are best solved by highly organized and creative engineering teams. These teams are even now supplying the building blocks for tomorrow's achievements.

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BELL Aircraft CORPORATION

POST OFFICE BOX 1

BUFFALO 5, NEW YORK

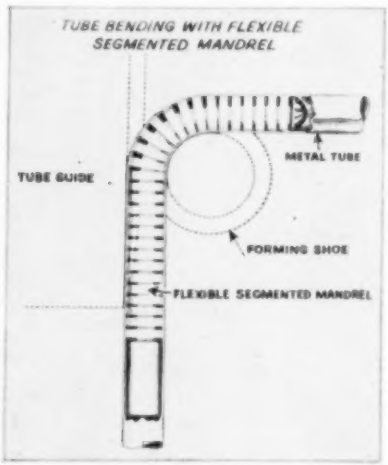
New Jersey Zinc Company luminescent pigment products. U. S. Radium will manufacture the pigment under its "Helecon" trademark.

Talley Corp., West Coast actuator and air valve manufacturer has established a new Electric Motor Division at its Newbury Park, Calif., facility. The firm plans to bring out a new line of light-weight motors under the guidance of William J. Forcey, formerly director of light-weight electrical motor design at Barber-Coleman Corp.

Longren Aircraft Co., Torrance, Calif., has received a contract for 2,584 wing spars at a cost of $300,000 from Boeing Airplane Co., Seattle.

Harvard Corp., 29 Porete Avenue, North Arlington, N. J. has set up a custom processing plant for Everlube "bonded" moly sulphide and graphite coatings.

By using nylon in tube bending mandrels, the bending operation goes better, tool delivery time is kept under better control (as nylon mandrels can be fabri-



cated in most shops within a few hours), and the tool cost is cut to one-third, Douglas Aircraft Co., Santa Monica, Calif., reports.

Poly (propene oxide) lubricant actually performs better when subjected to atomic radiation, California Research Corp. (Standard Oil of California subsidiary) scientists reveal. Dr. R. O. Bolt and J. G. Carroll of Cal Research have been allowed to present some of the findings of an originally secret search for lubricants to be used in atomic engines.

Two new high temperature gas turbine alloys have been announced by the International Nickel Company:

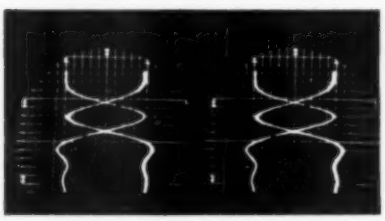
- **Inconel-700** which is claimed to be as

good at 1650F as Inconel-X has been at 1500F. Substituted for Inconel-X turbine buckets, Inconel-700's extra 150F turbine inlet temperature could upgrade certain engine performances.

Inconel-901, for less critical parts such as turbine rotor and compressor disks that must perform in the intermediate temperature range of 1,000-1,400F. The low coefficient of thermal expansion attributed to this metal by the makers would be desirable in these uses.

Despite flood damage Perkin-Elmer Corp., Norwalk, Conn., says that shipments are running over $1 million per month. Perkin-Elmer has formed two new operating divisions, the Instrument and the Engineering Optical, which will handle guided missile tracking instruments, bombsights, infra-red sensing systems, high-altitude aerial photographic lenses and other electro-optical systems.

A pendulum mass swings down towards another pendulum as part of Northrop's calibration for the accelerometers used on its SM-62 Snark missile guidance system. The poloroid camera films the output traces, as given by the dual-beam oscilloscope, of two accelerometers, both inside the stationary pendulum. If the production-line accelerometer's dynamic trace of impact vibration agrees with the trace of the standard calibrating accelerometer the production accelerometer is shipped.



Best mode of achieving urgently needed high-temperature jet engine materials is by use of once scarce tungsten in development of a low-alloy steel, says R. H. Thielemann, Stanford Research Inst., Menlo Park, Calif. Such a steel will have the thermal stability at high temperatures necessary to relieve residual stresses.

Development of an aerial gunnery training simulator with a visual target display so vivid that the trainees react as if they were actually on the enemy has been reported by the Akely Camera and Instrument Corp., N. Y. The system goes beyond Cinerama by completely surrounding the gunner with an hemispherical motion picture screen.

Aircraft Products Co., Bridgeport, Pa., makers of hydraulic and pneumatic aircraft components, have named Western Aircraft Supply Co. as exclusive representative in the Los Angeles area.

Firestone Tire and Rubber Co. will build a 75,000-ton capacity styrene plant at its Orange, Tex. works. When they can add styrene to their present butadiene facilities, Firestone will not only be the largest producer of synthetic rubber in the nation, but will be first in the industry to produce its own raw materials.

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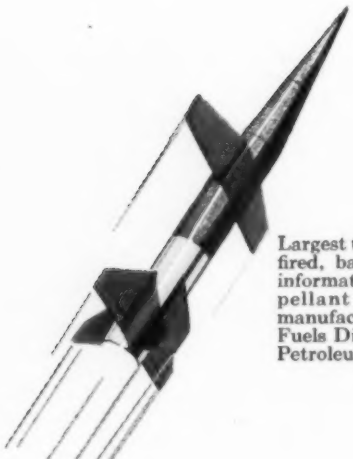
OPPORTUNITIES FOR
SCIENTISTS AND ENGINEERS



Largest thrust rocket ever fired, based on available information, used a propellant developed and manufactured by Rocket Fuels Division of Phillips Petroleum Company.

The M15 JATO, first of its kind to meet the most stringent Air Force performance tests, was developed by Phillips scientists and engineers.

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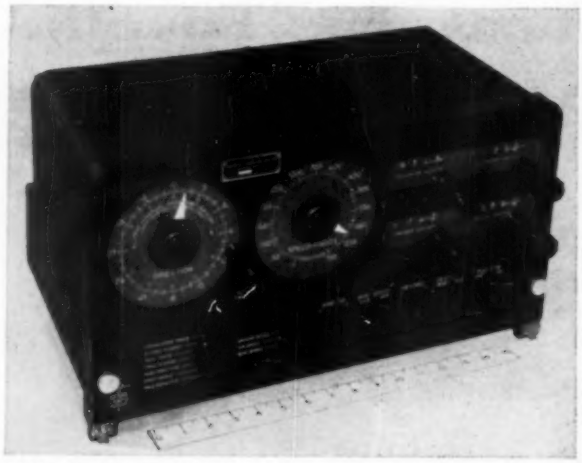
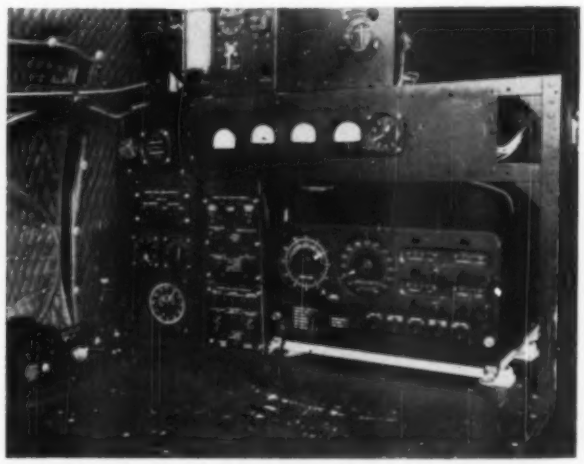


APN-66 PANEL SHOWS aircraft position, ground speed, wind speed and direction. Device gives pilot steering data to destination.



NEW DOPPLER AUTO-NAVIGATOR, AN/APN-66, shown in experimental C-54 installation, is completely independent of ground aids.

Automatic Navigation System Described

By Philip J. Klass

New details on the first self-contained fully automatic airborne navigation system to go into production, a combination Doppler radar-automatic dead reckoning system, have been revealed by the Air Force and General Precision Laboratory.

The new AN/APN-66, and a lighter-weight stripped down version, the AN/APN-82, enable an aircraft to navigate anywhere over the globe without reference to ground-based radio navigation aids. The systems are the forerunners of an even lighterweight version for military-airline use which GPL calls RADAN.

The AN/APN-66 gives the pilot or navigator a continuous indication of:

- **Present position** in latitude and longitude.
- **Shortest course** and steering signals to destination.
- **Ground speed.**
- **Drift angle,** wind speed and direction.

Missile Guidance

Although the Air Force will not permit disclosure of specific accuracy figures, GPL says that after a flight of several thousand miles, the APN-66 will bring the aircraft so close to its destination that the pilot can look below and see it.

With this type of accuracy, the APN-66, or modified versions of it, should be useable for blind bombing and missile guidance.

The APN-66, with its fully automatic operation weighs in at around 1,200 pounds, including cables and accessories. It consists of two major sub-systems:

- **AN/APN-81 Doppler Radar** which transmits pulses to the ground, then measures frequency shift in pulses reflected back to the aircraft. The frequency change is proportional to ground speed. (This "doppler effect" is responsible for the change in pitch in a train whistle as the locomotive speeds by.)
- **AN/APN-95 navigational computer,** an automatic dead-reckoning device which uses ground speed signals obtained from the radar, in combination with aircraft heading signals, to calculate how far and in what direction the plane has moved relative to its starting point and destination.

The APN-66 is being used experimentally in airborne early-warning aircraft such as the RC-121 and WV-2.

The APN-82, which weighs about half as much as the APN-66, is designed for use in tactical aircraft such as the RB-66 and weather reconnaissance aircraft. It employs the same Doppler radar, but uses a less complex AN/ASN-6 automatic dead reckoning computer made by Ford Instrument Division of Sperry-Rand.

Wind Drift & Computer

GPL says it is turning out the auto-navigators at a rate of $1.5 million worth per month, a figure which is expected to go up in coming months. Total contract awards to date approach $50 million.

The Doppler radar makes it possible to determine wind drift angle directly. GPL does not indicate how this is accomplished, but it might be done by measuring aircraft ground velocity relative to both the airplane's longitudinal and transverse axes. Another possibility is to rotate the antenna in azimuth until it measures a maximum ground speed component, then measure the angle between the antenna and the airplane's fore-aft axis.

In either case the radar data, compared with airspeed, makes it possible to come up with drift angle, wind velocity and direction—extremely useful for pressure pattern flying and for weather reconnaissance. GPL reports that AN/APN-82 equipped aircraft were able to accurately determine the position, speed, and direction of movement of last year's hurricanes "Connie" and "Diane."

Novel Features

The GPL auto-navigators both incorporate an integrator or "memory" which enables them to coast through periods of erratic or interrupted radar signal such as might be encountered during violent airplane maneuvers or over certain types of mountainous terrain. This memory stores the most recent useable information on aircraft ground speed and wind drift for use in dead reckoning until radar signals become useable. In this respect the APN-66 and -82 appear similar to the recently announced Lear SCAN auto-navigator (AW June 11, p. 71).

Another novel feature is a coordinate system translator which automatically comes into use when the aircraft is operating near the North or South poles. Because longitude angles change so rapidly at very high latitudes, the

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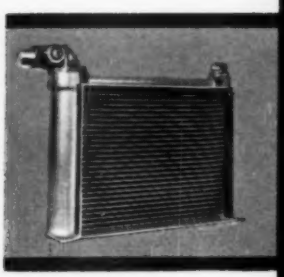
Straight up or straight down . . . heat's always on the level! That's because this 'copter has Harrison heat exchangers controlling vital engine and transmission oil temperatures. These coolers save weight and space . . . allow aircraft to carry payloads faster and farther. You'll find Harrison holding the heat line for peak performance on almost every type of modern aircraft. And Harrison's vast research facilities are constantly looking for *and finding* new ways of beating the heat. If you have a cooling problem, look to Harrison for the answer.

HARRISON RADIATOR DIVISION, GENERAL MOTORS CORP., LOCKPORT, N. Y.

GM GENERAL MOTORS



TEMPERATURES MADE TO ORDER

HARRISON

APN-66 automatically switches to transverse operation and makes its calculations as if the earth's pole were located on the equator at the 180 degree longitudinal meridian. Insofar as the pilot or navigator is concerned, he is unaware that the switch has been made because his panel indicator continues to show normal latitude and longitude. However, internally the computer is able to run through its computations with greater accuracy than with the conventional polar coordinate system.

The APN-66 also allows the pilot/navigator to select a new destination at any time, with the computer automatically calculating the course and steering signals to the new destination.

Askania Regulator Co., Kearfott, Librascope, and International Projector Corp., all, like GPL, affiliates of General Precision Equipment Corp., have contributed to the APN-66 and APN-82 program.

Competition

Although several other firms, including Ryan Aeronautical, General Electric, and Sanders Associates, are known to be working on Doppler auto-navigators, GPL claims that it holds basic patents and inventions in the field. GPL says it was the first to apply Doppler radar to air navigation and demonstrated the first such device for measuring ground speed and drift angle directly in 1948.

With so much activity in the field, it appears to be only a question of time before Doppler auto-navigators find their way into airline use, particularly in overseas carriers.

Expansions, Changes In Avionics Industry

General Electric will transfer its Communication Equipment operations from Syracuse, N. Y. to Gainesville, Fla., when a new $4 million, 300,000 sq. ft. facility is completed in 1958. The new facility will employ approximately 1,700.

Other recently announced expansions and changes in the avionics industry include:

- **Berkeley Division of Beckman Instruments, Inc.,** Richmond, Calif., has established a new Analog Computer Dept., headed by Joseph L. Hussey, formerly assistant chief engineer for computers. New department will handle sales, design, and field engineering.
- **Raytheon Manufacturing Co.** has sold the assets of its TV and radio operations to Admiral Corp., including two Chicago plants, to concentrate on present military-industrial equipment and components business which make up 90 percent of Raytheon's total business.
- **Texas Instruments Inc.** has purchased

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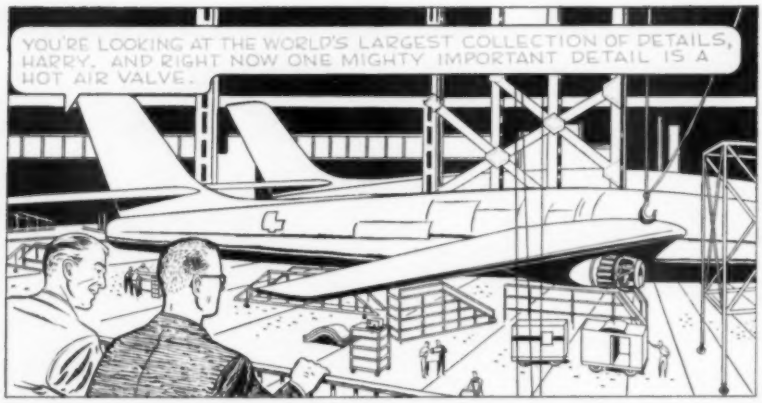
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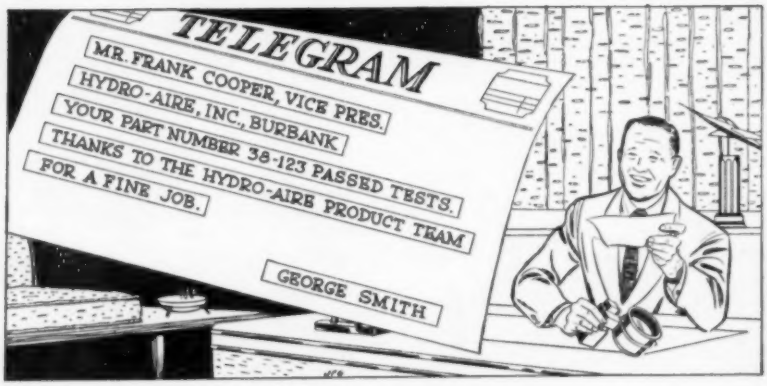
THE UNIT WE'RE HAVING TROUBLES WITH IS A 6" MOTOR OPERATED BUTTERFLY. OPERATING TEMPERATURE IS 440°F. THE UNIT WE HAVE FAILED IN TEST, AND WE ONLY HAVE 70 DAYS TO LICK THE PROBLEM. CAN YOUR PEOPLE HELP?
WELL, HYDRO-AIRE HAS PLENTY OF EXPERIENCE IN THE HOT AIR VALVE BUSINESS, GEORGE, AND WE'VE GOT THE RIGHT TEST FACILITIES. LET'S TAKE A LOOK AT THE SPECS... AND GET THEM TO BURBANK.
... INTERNAL OPERATING PRESSURE IS 58 PSI WITH AIR FLOW IN EITHER DIRECTION. THE MOST IMPORTANT REQUIREMENT IS TIME. WE MUST GET A PROTOTYPE TO THE CUSTOMER WITHIN THE NEXT 70 DAYS.
I THINK IT CAN BE DONE, HARRY. THIS IS SIMILAR TO A HOT AIR BUTTERFLY WE BUILT LAST YEAR. BUT WE'LL NEED A NEW AC MOTOR AND THE GEAR TRAIN WILL HAVE TO BE REDESIGNED. JIM WILL HAVE TO GET US CASTINGS IN A HURRY... AND WE'LL SET UP FOR PRELIMINARY TESTS.

THE PRODUCT TEAM GOES TO WORK!
LOOKS LIKE WE CAN DO IT, GEORGE. YES... I'LL HAVE THE DRAWINGS UP THERE NEXT WEEK.
CAN'T WAIT THAT LONG... WE NEED THOSE CASTINGS IN TWENTY DAYS.
TELL JOE TO GET THE TEST PROCEDURE READY BY TOMORROW MORNING.
THAT'S RIGHT, AUTHORIZE THE OVERTIME... WE'LL MACHINE THOSE BODIES OVER THE WEEKEND.
WELL, HERE IT IS HARRY. RIGHT ON SCHEDULE. AND IT PASSED THE PRELIM TESTS WITH FLYING COLORS.
THANKS, VIC. IF THIS PASSES THE TESTS AT THE CUSTOMER, WE'LL HAVE HELPED GEORGE TO SOLVE A MIGHTY IMPORTANT PROBLEM.



Notes on Hot Air Valves by Hydro-Aire

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the Wm. I. Mann Co., Monrovia, Calif., maker of optical components for lab and military use.

• **International Electronic Research Corp.,** Burbank, Calif., maker of heat-dissipating tube shields, has added 5,000 sq. ft. of additional manufacturing facility to its present building at 145 West Magnolia Blvd.

• **McColpin-Christie Corp.,** Los Angeles rectifier manufacturer, has changed its name to Christie Electric Corp., but emphasizes that there has been no change in organization, ownership or management.

• **Fairbanks, Morse & Co.** will move its Electronics Division from Davenport, Iowa, to nearby East Moline, Ill. Address: 1109 14th Ave.

• **Baird Associates, Inc., and Atomic Instrument Co.,** both of Cambridge, Mass., have obtained stockholder approval for merger. New firm will be called Baird Associates-Atomic Instrument Co.

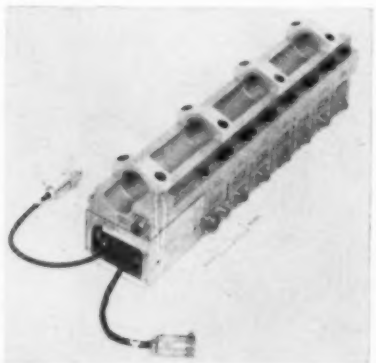
FILTER CENTER

▶ **What's In A Name?**—A.C. Spark Plug, division of General Motors, is making a slick transition to a new name to describe better its widespread activities in the avionics-electronics field. A few months ago, the company started inserting "The Electronics Division" between its name and that of General Motors in its advertisements. More recently the "spark-plug" has disappeared and company ads now are signed: "AC Electronics Division, General Motors Corp."

▶ **Tropospheric Scatter**—Cornell Aeronautical Laboratory, Buffalo, will study trans-horizon UHF communications employing tropospheric scatter techniques under recent contract awarded by Air Force Cambridge Research Center. CAL will set up receiving antenna on Lake Ontario, near Wilson, N. Y., to pick up a 915 mc. signal transmitted from Lexington, Mass., 395 miles away and monitor signal for 48-hour periods throughout the coming year.

▶ **Analyzing Sound**—The Naval Research Laboratory has developed a sound spectograph which presents an instantaneous plot of the energy of an audio signal as a function of frequency. The device is described in report PN 111864, "An Instantaneous Sound Spectograph," by R. D. Misner, NRL. Report is available from Office of Technical Services, U.S. Dept. of Commerce, Washington 25, D.C. Price: $1.00.

▶ **Looking For A New Home**—General Electric's Semiconductor Products Department, now located at Syracuse, N. Y., reportedly is casting about for a new location. Because of adverse effects of moisture and impurities on transistor quality, the site should have dry, clean air. Chambers of Commerce please note.



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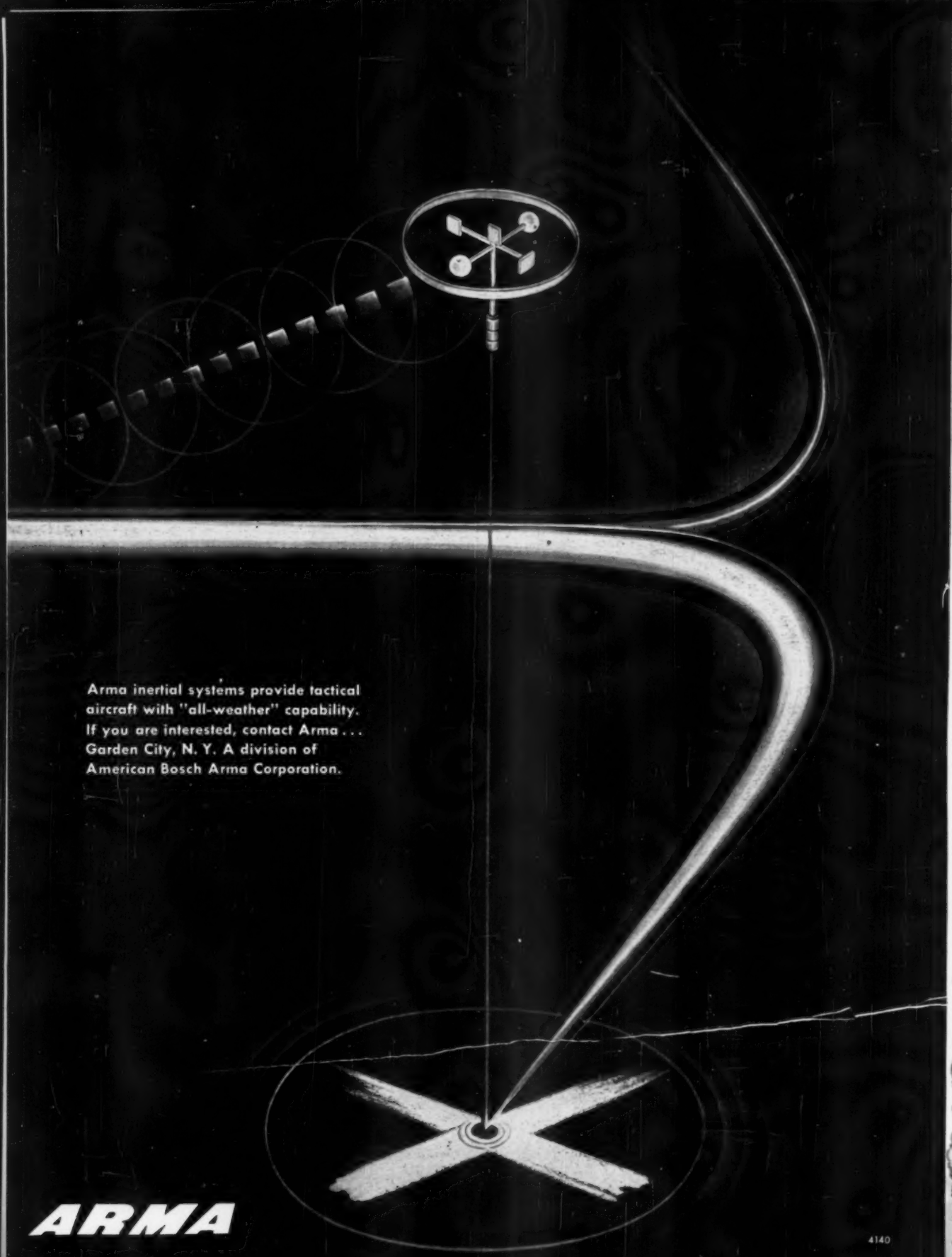
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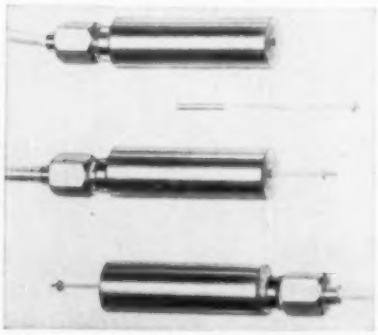
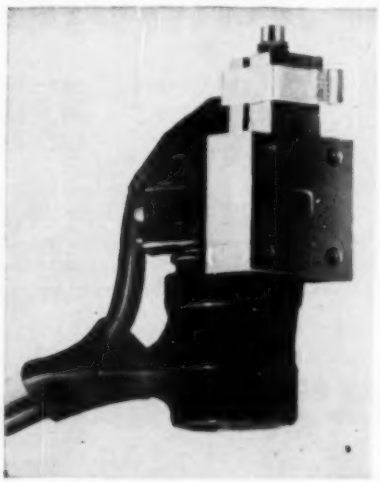


−160F to 1,300F. Pick-off is a variable permeance type. Crescent Engineering & Research Co., 11632 McBean St., El Monte, Calif.

• **Linear accelerometer,** Model A-10, has working range from 0 to 50G's, can operate up to 90,000 ft., has potentiometer signal pick-off. Accelerometer is air-damped, weighs 0.8 lb., measures 2⅛ in. diameter x 1¾ in. high. Unit is designed to withstand 15G shocks, with 11 ms. duration. American Gyro Div., Daystrom Pacific Corp., 3030 Nebraska Ave., Santa Monica, Calif.

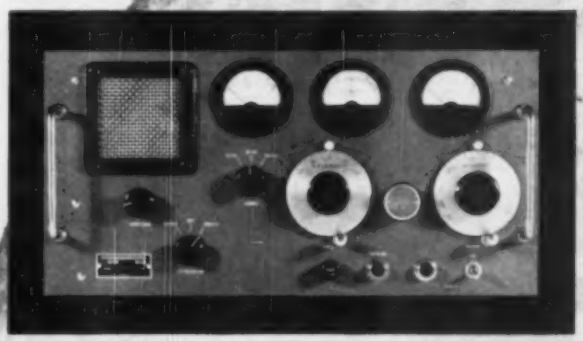
Microwave Devices

• **Miniature reflex klystron,** Type VA-97, is probably the smallest ever built, manufacturer says. New tube operates in 34.0 to 35.6 kmc. range, is designed for airborne use as a local oscillator. Only 400 v. beam voltage is



Nems-Clarke Inc.

Type 1400 RECEIVER



The Type 1400 is the first receiver designed specifically for telemetry applications to employ crystal control, extremely high adjacent-channel attenuation, and two separate IF channels. One channel is specifically designed for FM/FM telemetry, the other for PWM/FM systems. From the standpoint of selectivity, noise figure, distortion and stability it represents an outstanding advance. The specifications were written with the cooperation of the engineering staffs of the important missile test facilities of all the military services.

SPECIFICATIONS

Frequency Range	216-245 Megacycles determined by plug in crystals.
Input Impedance	50 ohms nominal.
Noise Figure	Less than 7 db.
Tuning	Tunable over a frequency range ± 150 KC's.
IF Bandwidth	Wide band—500 KC bandwidth at 3 db points. Attenuation ±500 KC from center frequency greater than 60 db. Narrow band—100 KC bandwidth at 3 db points. Attenuation ± 250 KC from center frequency greater than 60 db.
Signal to Noise Ratio	500 KC Passband. S/N ratio is 40 db for 2 uv of input carrier when carrier is modulated ± 100 KC at a 1000 CPS rate. 100 KC Passband. S/N ratio is 40 db for 1.5 uv of input carrier when carrier is modulated ± 30 KC at a 1000 CPS rate. The above S/N ratios are measured with a 2500 CPS RC lowpass filter at the receiving video output.
Panadaptor Output Frequency	Provision for connecting into a 30 MC panadaptor.
Deviation Meter	Peak reading over frequency range from 400 to 80,000 CPS. Three scales 25, 75 and 150 KC.
External Field Strength Meter	Output 10 milliamperes into 500 ohm load.
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Power Input	117v AC, 60 Cycles, Approximately 150 Watts.

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Left to right: Dr. Howard Baller (radar systems and counter-measures, computers); Dr. Cledo Brunetti, Director of Engineering and R & D (electronic design, automation); Donald F. Melton (nuclear handling, automation equipment); Dr. John E. Barkley, Associate Director for R & D (solid state, infrared)

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required for adequate power and electronic tuning. Slow motion broadband tuner is reportedly free from backlash. Companion klystron, the VA-94, provides comparable performance in the 16 to 17 kmc. Varian Associates, 611 Hansen Way, Palo Alto, Calif.

• **Dual TR shutter tube,** Model BL-317, with integral shutters, gives complete crystal protection over frequency range of 8.5 to 9.6 kmc., when used between balanced pair of short-slot hybrid couplers. Shutters operate on 28 v.d.c., and when closed present insertion loss considerably above 40 db. Tube is electrically identical to model 6334/BL-27, except for integral shutters which add only 4 oz. weight. Bomac Laboratories, Inc., Salem Road, Beverly, Mass.

New Avionic Bulletins

• **Magnetic tape data recording** equipment, including tape transports and amplifiers. Engineering Bulletins No. 3110, 3111, 3153, 3154, 4110, and 5102. The Davies Laboratories, Inc., 4705 Queensbury Road, Riverdale, Md.

• **Microwave tubes and components,** including TR, ATR, pre-TR, diodes, magnetrons, klystrons, and travelling wave tubes. (6 pp.) Bomac Laboratories, Inc., Beverly, Mass.

• **Synchros, servo motors and resolvers,** 138 types are listed and characteristics, bulletin No. 376. Precision Components Division, Norden-Ketay Corp., 555 Broadway, New York 12, N. Y.

New Airline Reserwriter

American Airlines-developed system, now undergoing trial at Buffalo, applies electronic datamation techniques to speed the handling of airline reservations information. Information on individual flight, including passenger's name, destination, interconnecting flights, is initially written by hand on special AA-designed card (left). Card then goes to key punch machine operator who transcribes written information onto punched card. Same information simultaneously is typed across top of card. Punched card then goes to Reserwriter (right), which automatically scans information on card, determines what information should be transmitted to other reservations offices (for interconnecting flights), automatically organizes the required message, and punches it out on a tape which feeds conventional teletype circuits. Reserwriter, built by International Business Machines Corp. to American's design, reproduces each message on an electric typewriter, stopping when the necessary teletype circuits are not available, or other special action is required (AW March 19, p. 65.) American is trying out other innovations at its Buffalo center, including a "satellite" Reservisor handset which enables Buffalo personnel to directly interrogate and sell space out of master reservation storage drum in New York City.

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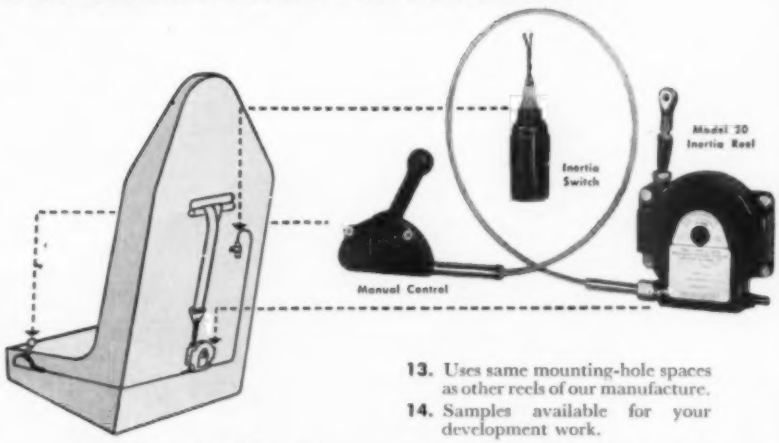

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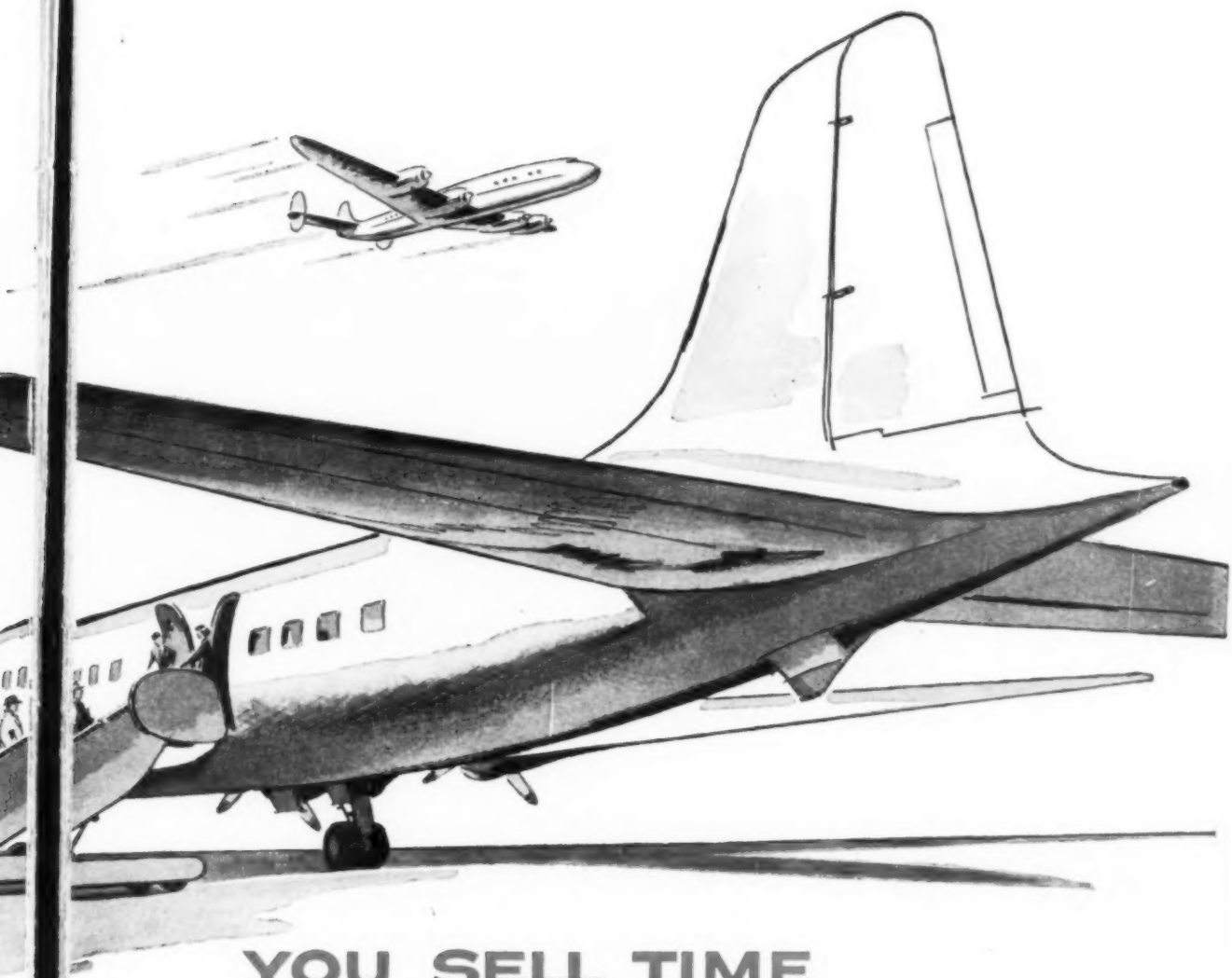

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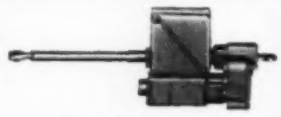

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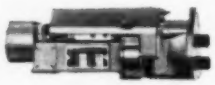

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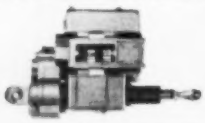

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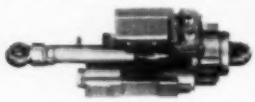

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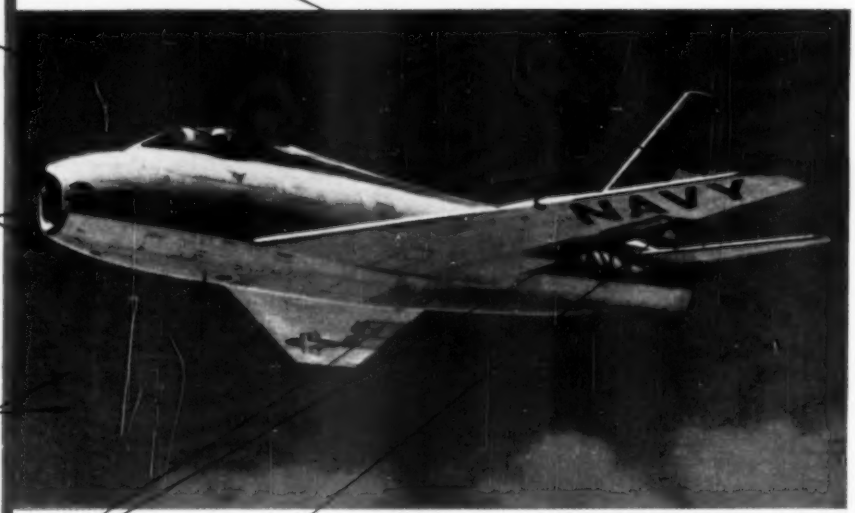

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Engineers Must Find Career Motivation

Economic survival of firm often depends on managements' motivation of engineering personnel.

By Leslie W. Ball*

The economic survival of a wide variety of businesses depends on the ability of their managements to motivate their scientific and engineering personnel. Even more important, this nation's survival in the type of war we are now fighting is very directly dependent on our success in the motivation of scientists and engineers.

Many businesses, particularly in the avionics industry, start off on the basis of the productivity of one or of a small group of men and they prosper until expansion brings them to a point where the efforts of the small group are not enough.

When the owners and managers of these businesses learn to motivate larger groups of scientists and engineers, they prosper and grow, sometimes at a meteoric rate. Conversely, if they do not learn how to motivate, then the business suffers growing pains so severe that they often destroy it altogether.

Money Isn't Everything

Reports from Russia leave no doubt that the communistic system is using every form of materialistic motivation to induce its scientists and engineers to perform miracles. In the United States during the last 15 years the free enterprise system has brought considerable improvement in the economic status of scientists and engineers.

But despite the improvement, the materialistic attractions of the loosely defined engineering and scientific professions are, and will remain, unfavorable when compared to sharply defined professions such as dentistry, medicine and law. It would be dangerously wrong to believe that in the free enterprise system money is the principal motivation that management must use to induce our scientists and engineers to out-perform our potential enemies.

The popular belief that the only problem in hiring or retaining scientists and engineers is that of providing salaries higher than those of the competition is one of the misconceptions that causes management to underestimate the importance of broader motivations. The relative importance of money and the more subtle motivations may have been demonstrated by the recent action of a group of scientists that quit one of the best known aircraft industry missile organizations. Information released to the public indicated that disagreement over the effect of organizational relationship on motivation was the dominant issue rather than money or any strictly materialistic problem.

Primary Motivation

Creative scientists and engineers are motivated primarily by an intense desire to follow a successful and ever progressive technical career. The seven specific types of motivations cited below are important in themselves, but they fall into proper perspective when we regard them as essential requirements for a successful and ever progressive technical career.

Admittedly the definition of a successful career will vary widely from, say, the case of an academic university scientist to that of a design engineer running his own aircraft component business.

Consequently, a motivation factor that is of great importance in one career may be relatively less important in another.

But the basic principle that career consciousness is a key factor in motivation applies to the great majority of all types of scientists and engineers.

LESLIE W. BALL

The general requirements for motivation of scientists and engineers include:

• **Competent, Inspiring Leadership:** Two thousand years ago, young mathematicians, astronomers and philosophers journeyed on foot across the continents to study with the leaders of their day. It was so with Socrates, Archimedes and on through Newton, Maxwell and Rutherford. So it is today all over the world, scientists and engineers seek an association with the great men of their own profession. Management recognition of this principle is to be seen in the advertisements of many companies which show pictures and name the great leaders under whom recruits will have the opportunity to work.

• **Specific Assignments and Objectives:** In order for a man to grow within his profession, he must tackle specific problems, learn and establish his reputation by solving them. Although many scientific and engineering projects do take the form of group efforts, the individual is not well motivated when his identity is lost within a large group. There is nothing inconsistent between group cooperation and achievement and specific assignment to individuals. It merely takes management skill in breaking up large tasks into individual responsibilities, or the breakdown of

Motivation Techniques

Aviation Week's recent survey of avionics engineers and companies revealed that the most significant factors that motivate engineers to change jobs are higher salary, greater responsibility and geographical considerations. (May 14, p. 64.) Techniques which management can employ to motivate engineers to more productive efforts and to stay put are suggested in this current article by Dr. Leslie W. Ball, technical director of United ElectroDynamics.

Dr. Ball obtained his PhD. in physics from the University of Manchester in England in 1933, coming to the U. S. in 1942 as associate technical director of Triplett & Barton, Inc. From 1946 to 1952, Dr. Ball served as head of the Evaluation Laboratory and later head of Physics Research Dept. at the Naval Ordnance Laboratory. Joining Wyle Laboratories in 1953 as technical director, Dr. Ball left in 1955 to take his present position.

* *Technical Director United ElectroDynamics Division, United Geophysical Corp.*

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VALVES AND FITTINGS FOR THE OIL AND AVIATION INDUSTRIES

United ElectroDynamics

United ElectroDynamics, a division of United Geophysical Corp., was formed late in 1954 to handle the firm's non-geophysical activities. These include research, development and production of telemetering, instrumentation and data processing equipment. Typical is UED's transistorized FM/FM telemetering system used on the Corporal missile and being considered for use in the Atlas and Sergeant missiles.

UED also operates complete facilities for functional and environmental testing of electronic and electro-mechanical equipment, with some facilities for hydraulics testing. The parent company, founded in 1935 by Herbert Hoover, Jr., was sold to the firms officers and area managers in 1954.

general functions into specific functions suitable for assignment to individuals.

• **Clear-cut Productivity Criteria** (for the measurement of performance of each individual): Even in the case of basic research, it is possible to set up methods of measuring the efficiency of the worker. It is obvious that many of the crude methods of measurement that are applicable to the machinist are not applicable to the research worker. However, without exception, criteria can be found and their establishment can aid in the motivation of the individual.

• **Tangible Evidence of Long-term Growth:** A machinist may be content to produce a beautiful job of construction today and an identical job ten years from now. However, the scientist or engineer must see that today he is able to do things and has knowledge that he did not possess even one year ago. It has been my observation that in the absence of other criteria of growth, the individual will demand salary increases partly because they justify his thinking that he has actually grown. If there is other tangible evidence of growth, he will be less insistent on salary increases and may disregard them altogether.

For example, at the present time I am trying to hire a man at an increased salary, but am having difficulty. The man is working on a project which gives him a great sense of growth in his own abilities and knowledge and is afraid that if he transfers, he may stand still professionally even though he advances financially.

Politics vs. Justice

Three other general requirements for engineer-scientist motivation include:

• **Administration In Which Justice Dominates Politics:** In order to have ample time for the acquisition of technical knowledge, the engineer or scientist must severely limit the amount of time that he devotes to political activity and to ensuring that his achievements are recognized and credited to him. If management fails to provide a system of justice in which each man's efforts are credited to him, the hard-working individuals will tend to leave and the organization will tend to become overloaded with politicians and parasites.

• **Need To Belong:** Although the scientist and engineer in general is an individualist, it is still necessary for management to make provisions for his "need to belong" by participating in the activities of his technical societies.

• **Need For Group Victories:** In addition to broader associations, there is, even among the least "long-haired" variety of down-to-earth practical engineers, a deep need to belong to a successful project team. Nothing builds morale and sense of belonging in such a team as well as regular achievement, or victories.

Management Techniques

It is management's responsibility not only to hire competent leadership, and to do so irrespective of cost, but also to give it effective support thereafter. Unfortunately this does not always hap-

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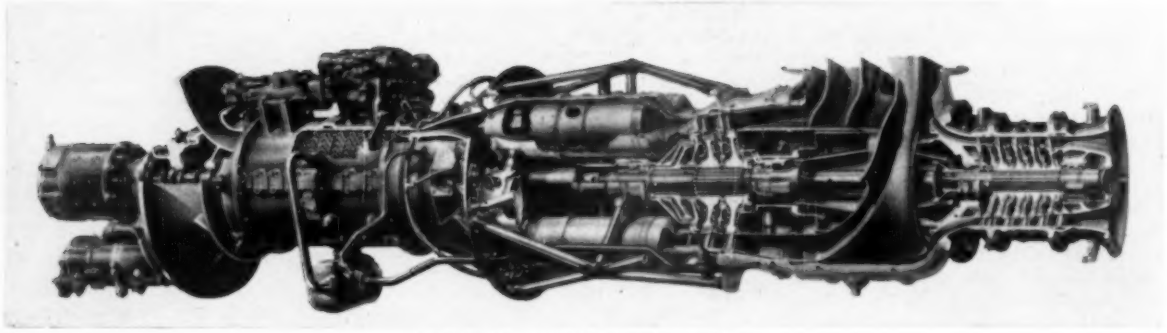


British Helicopter Jet

Napier Oryx N. Or. 4 turbo gas generator for helicopter propulsion has passed 150-hr. British type test at a rating of 865 gas hp. at takeoff. Engine is first British gas turbine to pass type test for helicopter application. Hot gases are ducted to rotor head and along blades for expulsion to blade tips, driving rotor by jet reaction.

pen. I have known quite a few cases where management has ordered that no expense be spared to obtain the services of a nationally known scientist. But after he has been hired it has lost interest in taking action to ensure that his reputation was maintained, or it has been unwilling to adjust its operations even when this has been necessary to make his leadership effective.

For example, when a scientist has built a reputation through the publication of his own research, he may be hired to lead and inspire a whole organization working on classified or commercial projects which will not produce new publications. A wise management will see to it that unclassified publishable work is performed, if for no other reason than to maintain the reputation that is an essential part of the scientist's leadership ability.

Inspiring Leadership

When a new manager finds that he has inherited a situation in which a man incapable of inspiring leadership has become a supervisor of creative scientists or engineers, it is his inescapable responsibility to replace that man immediately.

The manager may hesitate on the grounds that it is unfair to the one individual.

Even if this were so, the fundamental right of all scientists and engineers to be provided with competent leadership is so important that justice to the supervised must be preferred to indulgence to the supervisor. Many years ago I had to make such a decision when I found that a chemist, with no ability to lead in the field of mechanical design, had been placed in charge of a potentially brilliant group of young mechanical designers.

My predecessor had made the appointment because it was an expedient way of promoting the chemist. After his action had been reversed and a competent designer placed in charge of the group, its output of creative engineering was so substantial that I never doubted either the justice or wisdom of the necessary demotion. Moreover, a few years later the same chemist achieved notable success as the leader of a chemical group.

Clear-Cut Responsibility

Before specific assignments can be made to an individual, the overall program of organization must be conceived, created and sold. It is a management responsibility to see that this overall program does include all the elements necessary for the professional growth of the scientific engineering staff.

For example, when I became manager of the Mechanical Test Division of the Naval Ordnance Laboratory, the program included a great deal of testing that, either because it was classified or because it was routine, was not career-building. After test-method research projects had been obtained to supplement our regular program, the effect on the careers of the engineering staff was substantial.

Previously, none of the test engineers either belonged to a professional society or had published a paper, but within a year all belonged to at least one society and papers were being published at a rate of more than one per man per year.

Job Descriptions

A very important management technique for making functional assignments to individuals, as well as aiding the development of their careers, is the writing of position descriptions. Organization charts alone help to establish line authority, but it is impossible to define clearly what an individual must know and how he can advance himself unless an individual description is written for him.

Position descriptions provide also an excellent technique for establishing justice and for controlling the effects of personal friendships within an organization.

For example, one of my close friends who worked in my organization continually petitioned me for an increase in salary on the grounds that his family required an increase in standard of living.

The response was to give him the opportunity to undertake certain functions that would require increased skill and knowledge with the understanding that if he mastered the specific additional functions, they would be written into his (civil service) position description and automatically a salary increase would follow.

Over a period of the two years that was required for him to make the specified achievements his position description and salary remained unchanged without undermining friendship with his supervisor.

Productivity Criteria

Techniques that managements use to provide data for themselves are readily adaptable to providing information for the individual to judge his own progress.

The setting up of detailed budgets can and should be combined with the setting of detailed objectives for the individual. Likewise, the writing of progress reports can, in addition to providing information to the management, result in self analysis by the individual based on a comparison of the time and money that he has spent compared with the progress that he has achieved.

An effective method for contributing to justice and the control of politics in a technical organization can be provided by having each man produce written evidence of his own personal contributions and providing a two-level review of this work. This plus periodic discussions between each manager and men two levels below him can serve

to establish their specific individual contributions, as opposed to the collective output reported by the intervening supervisor.

Group Victories

A good administrator will set a series of specific objectives he is confident can be attained.

If the project is broad and will take several years to complete, he will set goals which can be achieved at intervals of a few months.

Then he will publicize each objective and ensure that its achievement is used to generate a feeling of group victory among all the cooperating scientists and engineers.

Skillful planning and conduct of staff meetings can be used to give the individual a feeling of belonging to the team, partly by providing the opportunity for him to express his own ideas. Meetings at which individuals or small groups can report success in achieving short-range objectives contribute to the feeling of group victories. This can also be achieved by bringing in representatives of the organization for whom the work is being done, so that they can express their appreciation to members of the group.

In summary, the motivation of scientists and engineers in America today is a very major factor in both local business and national defense. The price of management failure to motivate always is heavy in terms of profit. In National Defense it could be disastrous.

British Show 100-mi. Rocket at Open House

London—Wraps have been taken off some British rocket developments, including a test vehicle designed to carry instruments to 100-mi. altitudes during the International Geophysical Year. Occasion was the open house of the Rocket Propulsion Department of the Royal Aircraft Establishment Westcott firing range.

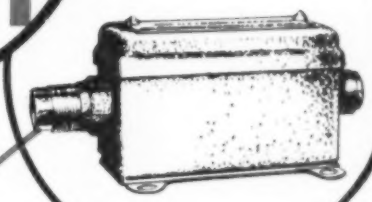
The test vehicle has a simple solid propellant motor called Raven that gives 11,500 lb. thrust for 30 sec. A smaller motor—Mayfly—has a 260-lb. cordite charge and develops 18,000-lb thrust for 2.7 sec. Liquid fuel rockets revealed:

- **Beta.** This rocket has two combustion chambers swiveling about a perpendicular transverse axis. It is to lift the Fairey VTO project.
- **Gamma.** Variable thrust motor with two chambers provides 8,000-lb. thrust for takeoff, 2,000-lb. thrust for combat, and 800-lb. for cruise. It burns high test peroxide and kerosene.

Test stand for a liquid fuel motor of 200,000-lb. thrust is under construction.

Rocket bodies shown were formed by deep drawing techniques, as shell cases

GLA ignition . . .



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By thus reproducing the conditions of an actual high-performance aircraft or missile in flight, the unit expands the capabilities of any testing laboratory. Write for your copy of the descriptive brochure.

SPECIFICATIONS

Roll Acceleration, approx max	40,000 deg/sec^2
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Pitch Velocity, approx max	150 deg/sec
Yaw Velocity, approx max	125 deg/sec
Roll Displacement, max	±120 deg
Pitch and Yaw Displacements, max	±90 deg
Signal Sensitivity	1.8 deg/volt
Linearity	0.1 %
Servo Accuracy	±0.5 deg
Inertia Load Limit for Flight Table	3 lb-in.-sec^2
Equipment Test Volume, cylindrical	17-in. diam by 13 in.

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are. One case had diameter of 9 in. and was 53-in. long.

The British also are using continuous casting method for forming light alloy annular fuel tanks.

Research exhibits in guided missile field indicate much work is being done on transmission of radio waves through ionized rocket exhaust streams. In the metallurgical field, silicon carbide appears to be replacing resin bonded asbestos in nozzles.

Use of sintered stainless steel and bronzes for gas cooled porous walls is probable.

Contract Awarded To Air-Condition DC-8's

Douglas Aircraft Co. has awarded a contract for over $1 million to Carrier Corp. for vapor cycle cabin air conditioning equipment for its DC-8 jet transports.

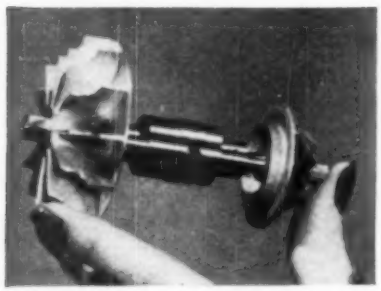
Two of the light weight (150 lb. each, pneumatically-driven units will be installed in each plane's belly, behind the cockpit.

Heart of the machine, each of which is powerful enough to cool seven average-size houses, is a centrifugal compressor whose rotor tip speed is 1½ times the speed of sound.

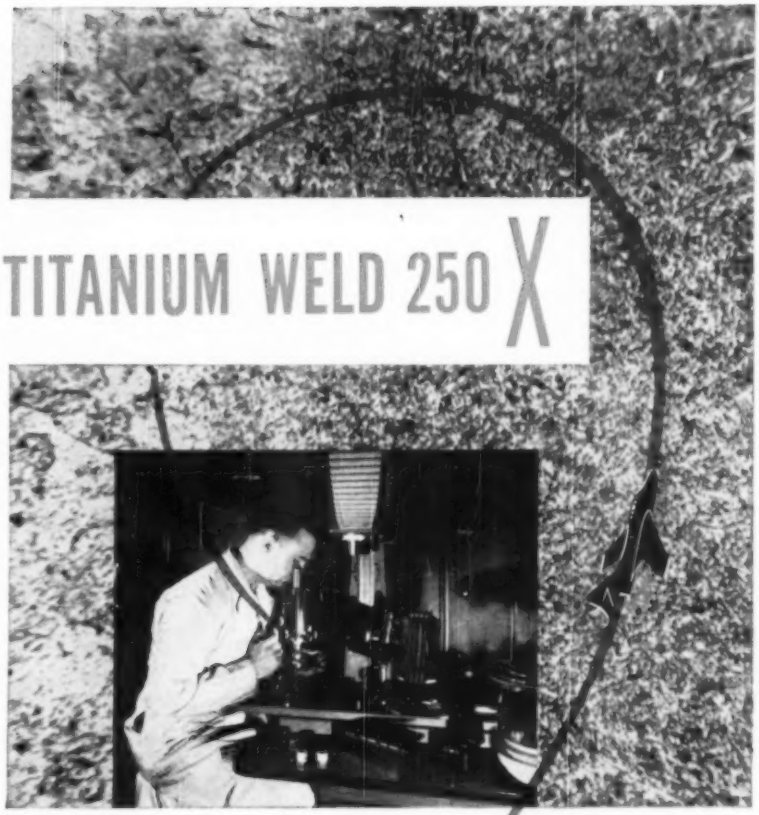
Carrier says that it decided to go to a vapor cycle system instead of the more conventional air cycle system because the vapor cycle type automatically removes moisture from the air. With an air cycle system, special additional equipment is necessary to remove moisture.

The cooling units will be driven by air bled from the jet engines' compressors. When the engines are shut down, a mobile ground source will supply the necessary compressed air.

Carrier designed and built the cabin refrigeration equipment now flying in most of Douglas' DC-7s (AW April 23, 1953, p. 66).



ROTATING ASSEMBLY in Carrier Corporation's device for air conditioning Douglas DC-8 jet airliners. Turbine at left is driven by compressed air from airliner's jet engine. Rotor at other end of shaft generates cooling air. Entire compressor assembly weighs about eight pounds.



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The microscopic inspection equipment and actual photomicrograph of a titanium automatic heliarc butt weld 250x, shown above, are typical of the quality control techniques employed by Lavelle to assure *production perfection* of critical parts and components for the aircraft industry.

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Additional data on Lavelle's specialized fabricating services is contained in this illustrated brochure. Write for a copy without obligation.

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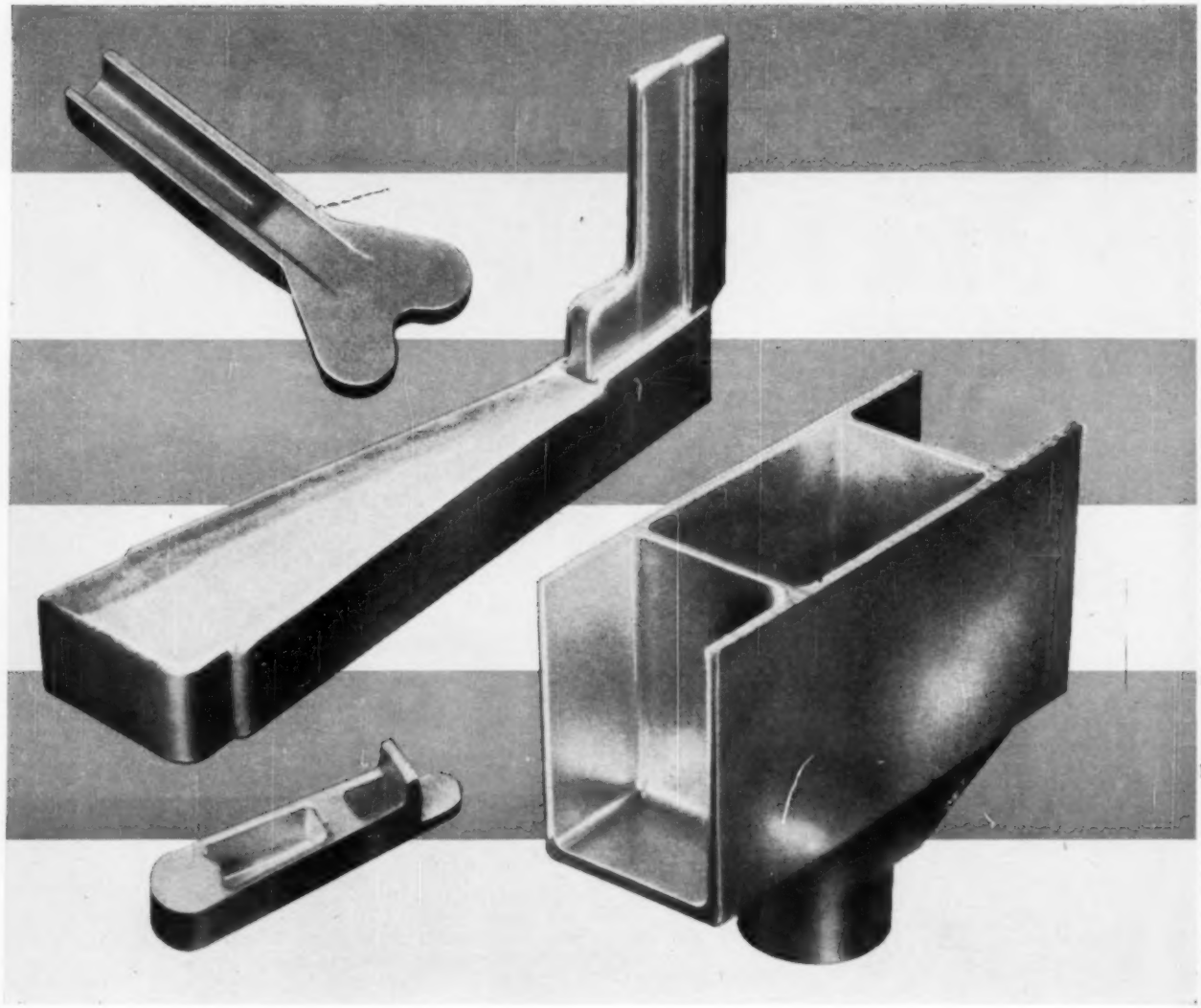

No-draft forgings by Kaiser Aluminum

KAISER ALUMINUM'S Erie plant has been successful in meeting its customers' ever-growing needs for no-draft forgings.

Shown on these pages are a few of the many no-draft forgings produced by Kaiser Aluminum on *existing equipment* for the aircraft industry.

Additional equipment—especially designed for no-draft forgings—will soon be installed to greatly increase our capacity for these specialized forgings.

Kaiser Aluminum no-draft forgings give you the benefits of substantial cost savings through the elimination of machining, plus extremely light weight with high strength, close tolerances, and superior finish.

When you submit your aluminum forging inquiry to Kaiser Aluminum our highly skilled engineering staff will evaluate the forging to determine its suitability as a no-draft forging.

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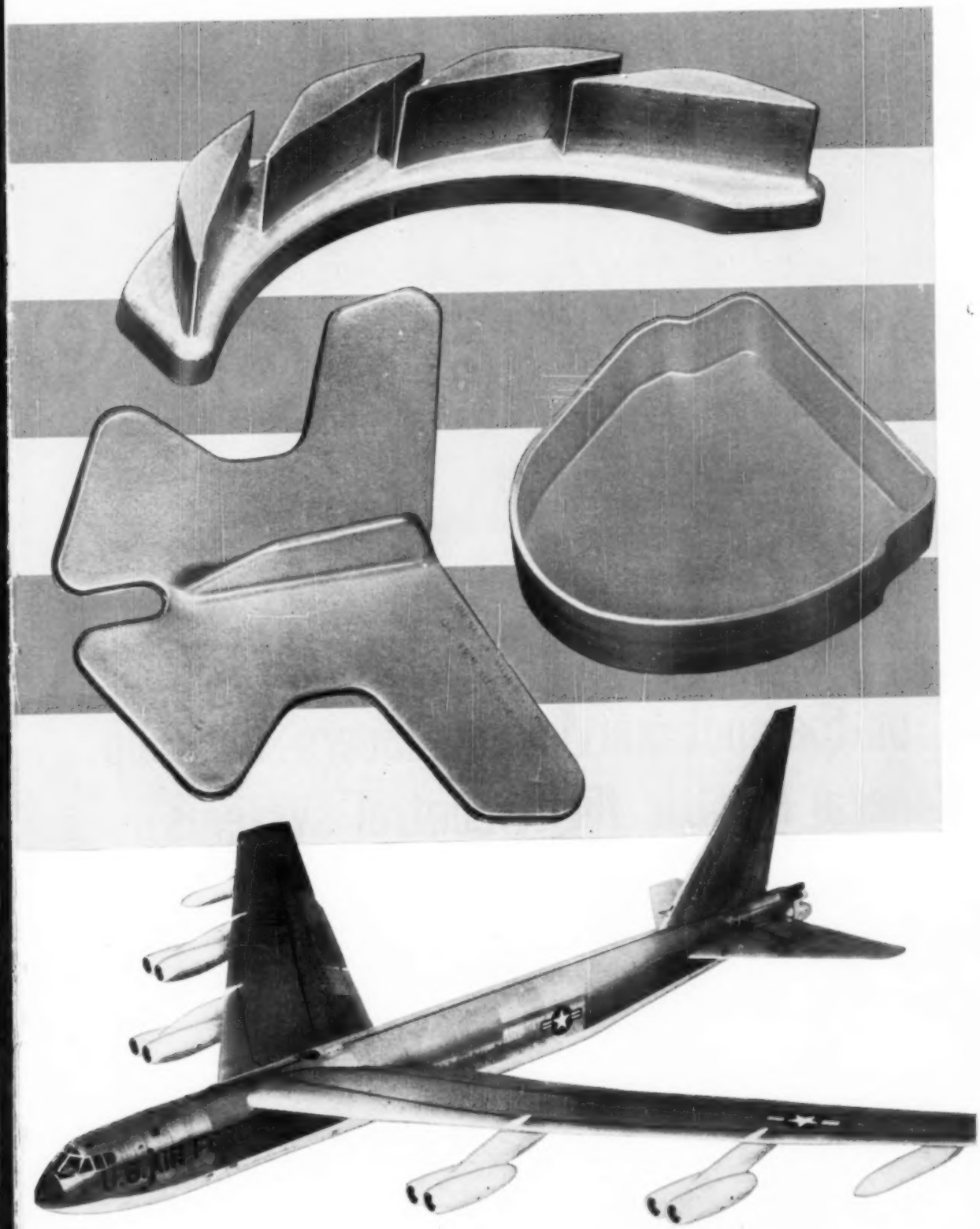
Kaiser Aluminum & Chemical Sales, Inc., *General Sales Office*, Palmolive Bldg., Chicago 11, Illinois; *Executive Office*, Kaiser Bldg., Oakland 12, California.

Kaiser Aluminum



NAVY AVIATION ELECTRICIAN and G-E "tech rep" check out flight stabilization system on Chance Vought F7U-3 Cutlass.

How on-the-spot service engineers back up General Electric flight control systems

G-E SERVICE ENGINEER, Willie Jaques, demonstrates the autopilot line maintenance tester to Navy aviation specialists.

G-E field service engineers provide valuable technical assistance to the Armed Forces wherever service is required on General Electric flight control systems. These "tech reps" also conduct classes for pilots and aviation specialists on the operation and maintenance of G-E flight control systems.

In addition, General Electric service engineers make detailed field operation reports on flight control system performance. These reports provide design engineers with information on system performance on operational aircraft for improving future G-E flight control systems—systems that are now being designed and built for the latest supersonic aircraft.

FOR DETAILED INFORMATION on the flight control systems that General Electric is designing and manufacturing for our Armed Forces, contact your G-E Aviation and Defense Industries Sales Office. Section 221-9, Schenectady 5, New York.

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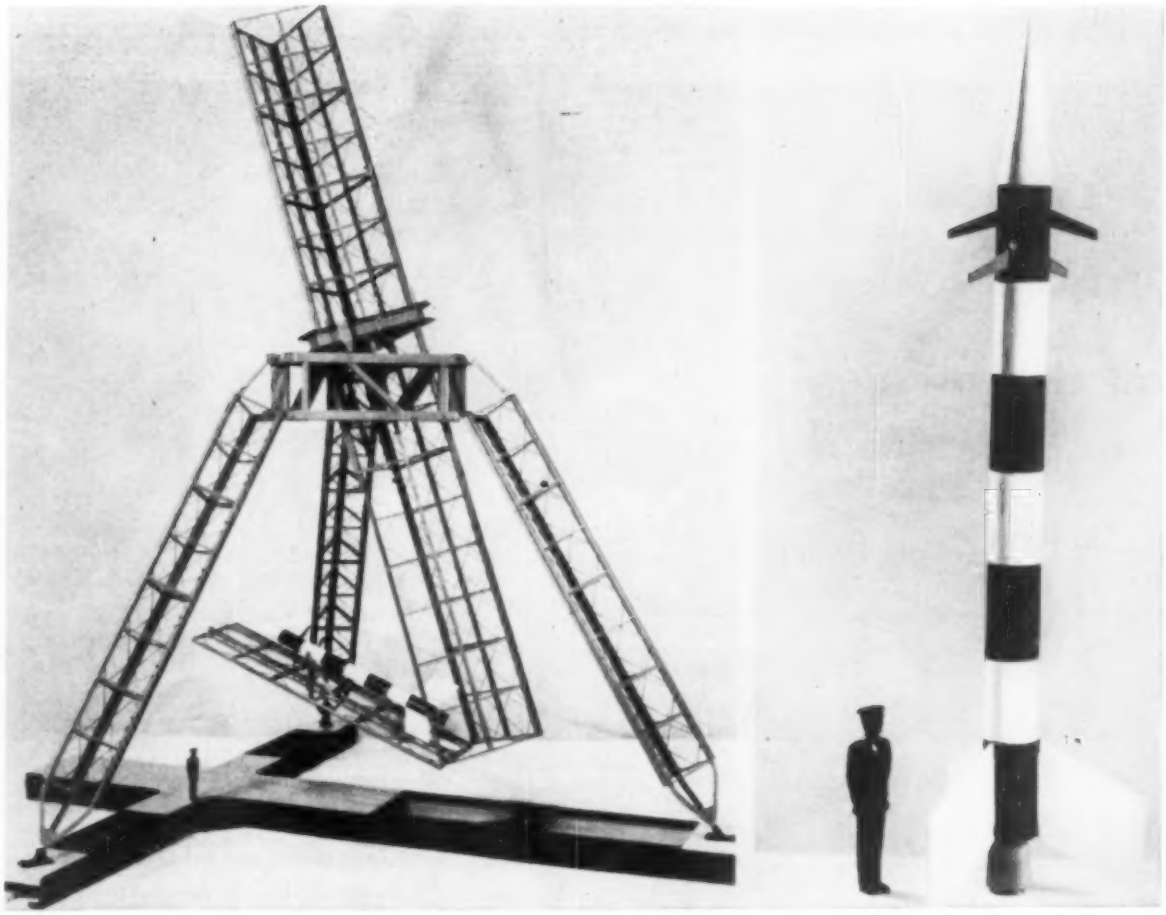

British Rocket and Launcher

High altitude rocket and launcher designed by British Ministry of Supply Aircraft Establishment for Royal Society's program for upper atmosphere research. Rocket is 25 ft. long, 17 in. in diameter, propelled by solid fuel. Research instruments are in nose cone and part of the body. Rocket is designed to go to height of more than 100 mi. Tilting tower's height: 81 ft. Weight: 35 tons.

Navy Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Navy Contracting Offices:

BUREAU OF AERONAUTICS, Washington 25, D. C.

Sperry Rand Corp., (Ford Instr. Co. Div.), 31-10 Thomson Avenue, L. I. City 1, N. Y., conduct a study to determine the feasibility of a slide rule or other mechanical calculation device which can determine how much load a helicopter can carry under specific altitude temperature wind and humidity conditions, design, develop and manufacture one (1) each "Breadboard" type instrument or instruments and manufacture and furnish twelve (12) production type instruments, NOas 55-856-c (PP-60-788-55) $39,132.

Raytheon Mfg. Co., 100 River St., Waltham 54, Mass., APN-22 receiver, transmitters, amplifiers, indicators, mounts, housing, etc., NOas 56-266-f (PD-32-726-56), 716, $1,339,845.

Aerojet-General Corp., Azusa, Calif., fabricate and furnish 1, SKS7800X113C7 motors, NOas 56-38-r (PD-24-2494-55, change A; 397-56, 398-56, 399-56), 628, $709,766.

Kittell-Lacy, Inc., 714 W. Olympic Blvd., Los Angeles 15, Calif., fabrication and installation of single semi-portable, 30000 pound thrust capacity turbo-jet engine test facility, NOas 56-539-f (MA-56-5116-56), 9, $405,509.

Test Institute Corp., 3188 W. 32nd Street, Cleveland 9, Ohio, prepare test set-ups and conduct tests on Gov't-furnished check valves, pressure relief valves, shuttle valves, thermal relief valves and controllable check valves, NOas 56-453-c (AE-61-1915-56), $62,782.

International Research & Development Corp., 797 Thomas Lane, P.O. Box 1707, Columbus 16, Ohio.

Airpath Instrument Co., St. Louis, Mo., standby compass, AN5766T4, NOas 56-321-f (PD-42-1144-56 & Changes A&B), 3544, $67,374.

Kollsman Instrument Corp., 8008 45th Ave., Elmhurst, L. I., N. Y., pressure altimeters, MS28044-1, NOas 56-414-f (PD-42-1131-56), 1215, $86,690.

Universal Match Corp. (Armament Div.), P.O. Box 191, Ferguson 21, Mo., design, develop, fabricate and furnish prototype pilot protective helmet assemblies with energy absorption linings, NOas 56-417-c (AE-52-1826-56), 28, $38,298.

Aerosonic Instrument Corp., 528 Reading Road, Cincinnati 2, Ohio, rate of climb indicators, AN5825-7, NOas 56-420-f (PD-42-1283-56), 798, $55,000.

Wilding Picture Productions, Inc., 1345 Argyle Street, Chicago 40, Ill., preparation of master shooting scripts with partial storyboards for and proction of (5) motion picture training films, NOas 56-520-f (PH-51-2492-56), $57,963.

Continental Aviation and Engineering Corp., 12700 Kercheval Ave., Detroit, Mich., services of factory trained field technicians to provide instruction to Naval and Marine Corps personnel in the maintenance overhaul servicing and modification of R975 engines installed in helicopters operated by the Navy, NOas 56-193-s (MA-33-4428-56), $32,079.

Edo Corp., College Point 56, L.I., N.Y., aero 14 series airborne spray tank flight demonstration models, NOas 56-535-f (MA-36-4558-56), 20, $105,631.

Kollsman Instrument Corp., 80-08 45th Ave., Elmhurst 73, N.Y., periscopic sextants and mounts, NOas 56-554-f (PD-42-1274-56), 668, $1,098,779.

BUREAU OF ORDNANCE, Washington 25, D. C.

General Tire and Rubber Co., Wabash, Ind., steel spacers for 2.75 rocket motors, BuOrd dwg. 457230 Rev. A, NOrd-16954, (IFB Neg. Ma3a2-71-56), 800000, $29,600.

The Hicks Corp., Boston, Mass., fabrication of inert guided missile booster components for Terrier growth program, (NOrd-16862), $107,361.

AVIATION SUPPLY OFFICE, 700 Robbins Ave., Philadelphia 11, Pa.

General Radio Co., Cambridge, Mass., Variable capacitance testers, (383/29067-2682/3/56), various, $440,108.

The New York Air Brake Co., Watertown, N. Y., hyd. pump asys., (383/29043-214x3/-3/56), various, $157,295.

Pioneer Central, Bendix Aviation Corp., Davenport, Iowa, maintenance parts for various instruments, (383/2120-647x6/3/52), various, $33,523.

Buick Motor Div., General Motors Corp.,

Pictured above is just one example of Rohr-built Pow-R-Pax that have made Rohr famous around the world. In addition to the Convair 440 — Rohr builds the Pow-R-Pax for many other famous military and commercial airplanes including the Boeing KC-135, Douglas DC-7, and the Lockheed Super Constellation.

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AIRCRAFT CORPORATION

Chula Vista and Riverside, California

Flint 2, Mich., maintenance & spare parts for J65 engines, (383/2117-14/53), various, $64,199.

Champion Spark Plug Co., 900 Upton Ave., Toledo 1, Ohio, spark plugs, (383/-29081-7x5/1/56), various, $271,000.

Avien, Inc., 58-15 Northern Blvd., Woodside 77, N. Y., indicators, (JD383/2120-603/52), various, $31,824.

The Glidden Chemical Co., 1717 Summer St., Hammond, Ind., pigment, (155-1800-51F/56), 160000 lbs., $90,872.

Consolidated Diesel Electric Corp., Stamford, Conn., test stand, (383/23263-152/19/-56, 383/23263-3952/16,17/56), various, $72,-236.

Airesearch Mfg. Co., 9851-9951 Sepulveda Blvd., Los Angeles, Calif., hyd. pump., (383/2150-465/53, 383/2150-1078/52), 30 ea., $234,513.

Scintilla Div., Bendix Aviation Corp., Sherman Ave., Sidney, N. Y., tools supporting Scintilla magnetos, (38323263-89-8Z/-15,17/56), various, $47,896.

Pioneer-Central Div., Bendix Aviation Corp., Davenport, Iowa, maintenance parts, (383/2150-1219/52), various, $45,060.

Aviators Clothing Co., Inc., 143 Main St., Beacon, N. Y., flying summer suits, (383/-29045-35G3/23/56), 25750 ea., $305,910.

Aviators Clothing Co., Inc., 143 Main St., Beacon, N. Y., flying jackets, pants, (383/-29045-51G3/19/56), various, $30,262.

Pioneer-Central Div., Bendix Aviation Corp., Davenport, Iowa, maintenance parts, (383/2150-1865/X2/4/51), various, $39,594.

McDonnell Aircraft Corp., P. O. Box 516, St. Louis 3, Mo., spare parts F2H-3 AC, (383/9504-13/56), various, $92,223.

The ARO Equipment Corp., Enterprise & Trevitt St., Bryan, Ohio, individual diluter, (MIPR-33-600-4-IOL,-2231 9A), various, $154,196.

Bell Aircraft Corp., P. O. Box 482, Fort Worth, Tex., HTL spare parts, (383/2110-2055 A 5/5/51), various $32,898.

Lenoir Wood Finishing Co., 284 E. Harper Ave., Lenoir, N. C., spraying lacquer, (IFB-383-765-56), various, $26,849.

Knapp Monarch Co., 3501 Bent Ave., St. Louis 16, Mo., cylinder for vest-type life preservers, (IFB-383-746-56), 314496 ea., $36,096.

North American Aviation Inc., Columbus Div., 4300 E. 5th Ave., Columbus 16, Ohio, ground handling equipment for AJ A/C, (383/2110-1830/51), various, $150,386.

Breeze Corp., Inc., 700 Liberty Ave., Union, N. J., parts for various asys, (383/-2116-140/52), various, $32,404.

Army Contracts

Following is a list of unclassified contracts for $25,000 and over, as released by Army Contracting Offices:

CORPS OF ENGINEERS, Office of the District Engineer, Jacksonville District, 575 Riverside Ave., Jacksonville, Fla.

Daniel, Mann, Johnson & Mendenhall, 4201 Sunset Blvd., Los Angeles 39, Calif., contractor has subcontract open for Acoustical Engineering, architect-engineer services in connection with design of launching facility, Patrick aux. No. 1 AFB, Cocoa, Fla., (Negotiated), $69,663.

Alexis B. Kononoff, Consulting Engineers, 620 N.W. 32nd St., Miami, Fla., architect-engineer services in connection with design of target intelligence training building and engine build-up at Ramey AFB, Puerto Rico and target intelligence training building at McDill AFB, Florida, (Negotiated), job, $25,845.

J. A. Jones Construction Co., P. O. Box 966, Charlotte, N. C., construction of G/M control facility No. 1, AFMTC, Patric AFB, Fla., (ENG-08-123-(NEG-56-4), job, $536,-507.

CORPS OF ENGINEERS, U. S. Army, Office of the District Engineer Tullahoma District, P.O. Box 2091, Tullahoma, Tenn.

Hydromotive, Inc., 6723 Denison Ave., Cleveland, Ohio, Contract No. DA-40-126-eng-228., furnishing hydraulic accumulators for gas dynamics facility, Arnold Engineering Development Center, Tullahoma, Tenn., (IFB ENG-40-126-56-42), lot, $43,186.

Pan American to use SKYDROL in first U. S. jet liners

Twenty-five long-ranged Douglas DC-8s, powered by P&W JT-4 engines, will be delivered to PAA starting in December 1959.

Pan American's twenty Boeing 707s, scheduled for delivery beginning in December 1958, will include 12 JT-4 powered "Intercontinental" versions.

Typical flight times for both the Douglas DC-8 and the Boeing "Intercontinental", will be New York-London in 6 hours, 15 minutes; Tokyo-Seattle in 8 hours, 32 minutes.

Pan American's mammoth order for 25 Douglas and 20 Boeing commercial jets is the largest aircraft order ever placed by a private company . . . the first firm purchase of jets ever made by a U. S. airline. And Pan American recognizes that the jet age is also an age of high-performing synthetic lubricants. The company has specified fire-resistant Skydrol fluids to be used in the hydraulic systems of both types of aircraft.

Skydrol fluids offer safety, higher lubricity than petroleum fluids, which means longer pump life, less maintenance and greater operating economy. Whatever your hydraulic fluid needs, there's a Skydrol "tailored" for the job—in jets as well as piston engine aircraft! For more information, write Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, Dept. SKD-8, St. Louis 1, Missouri.

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34 MAJOR AIR CARRIERS NOW USING SKYDROL

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PAN AMERICAN	SWISSAIR	ANA
CANADIAN PACIFIC	UNITED	ARAMCO
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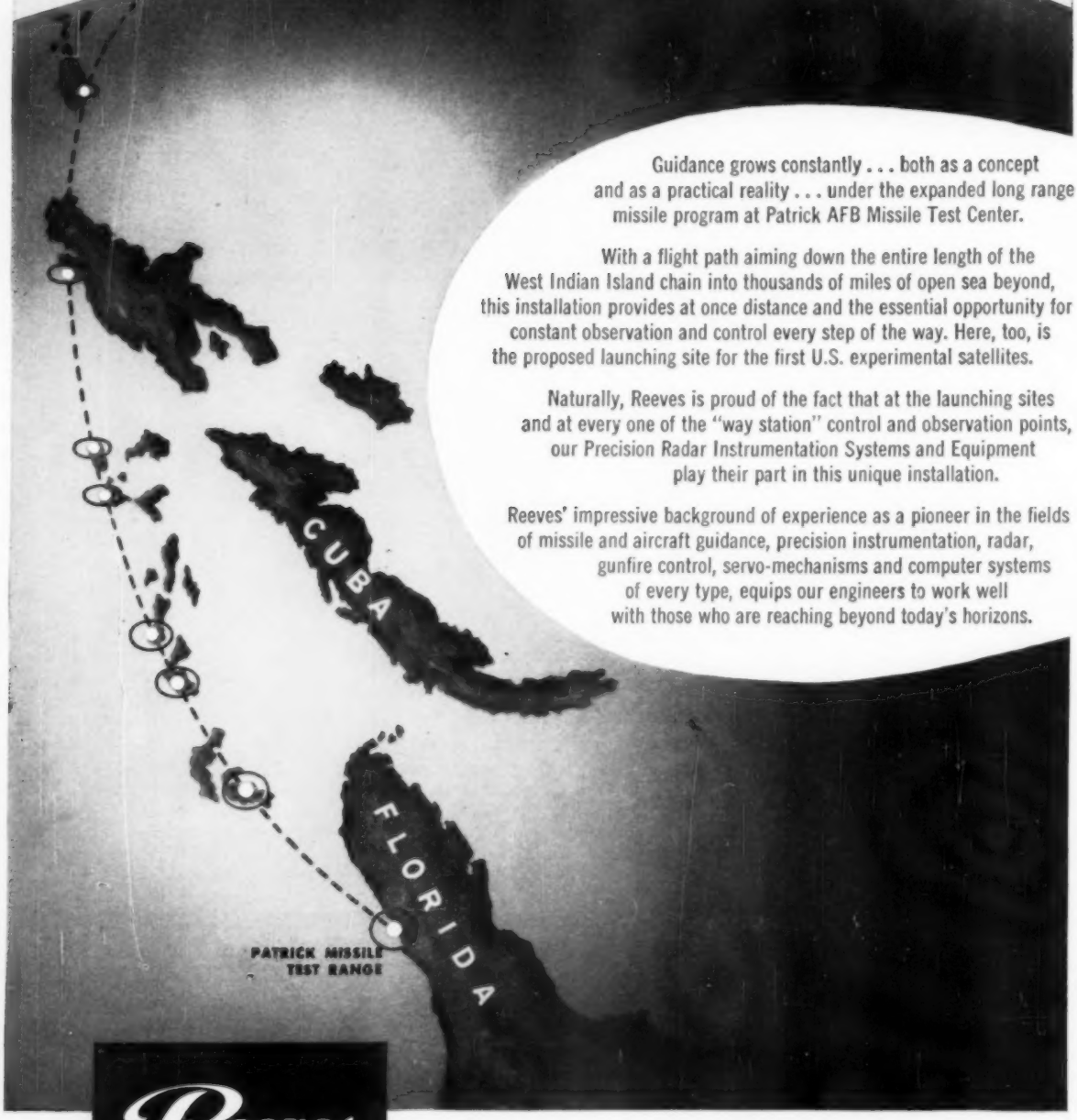

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USAF Contracts

Following is a list of unclassified contracts for $25,000 and over as released by Air Force Contracting Offices:

AMC, WRIGHT-PATTERSON AIR FORCE BASE, Ohio.

The Roflan Co., Corner Route 1 and Camp Meeting Road, Topsfield, Mass., antennas, AT-598/APT, 4519 ea., antennas, AT-600/-APT, 4519 ea., (PR 666540), $224,684.

Elcore, Inc., Chicago, Ill., inverter, 769 ea., (PR 235856, 672757 & 635581-1) $92,-045.

Bendix Aviation Corp., Bendix Products Div., South Bend 20, Ind., component spare parts, (PR PE-671293), $74,346.

Eastman Kodak Co., 343 State St., Rochester, N. Y., cine special motion picture camera II, 67 ea., Kodak signet 35MM still camera, 11 ea. (MIPR R56-51-23375-G 6/1, 2, 6/ASO, $78,848.

General Motors Corp., Allison Div.-Aeroproducts Operations, Dayton 1, Ohio, aeroproducts propellers and spares for C-130 aircraft, (PR 672420), $5,500,000.

Westinghouse Electric Corp., 32 North Main St., Dayton, Ohio, generators, 1356 ea., regulators, 1356 ea., panels, 1327 ea., (PR 665102 and 665166), $2,759,106.

Westinghouse Electric Corp., 32 N. Main St., Dayton, Ohio, generators, regulators, transformer assemblies, spare parts and data, (PR PE-635556 and 635558), $664,468.

Collins Radio Co., Cedar Rapids, Iowa, receiver-transmitter, 379 ea., tuning unit, 210 ea., (PR 168069), $2,169,989.

Continental Aviation & Engineering Corp., Detroit 15, Mich., facilities for the production of J-69 engines and MA-1 gas turbine air compressors, (PR 672931), $1,992,000.

Helicopter Div., Bell Aircraft Corp., P. O. Box 482, Fort Worth, Texas, Model H-13H helicopters for D/A, revisions to data, winterization and litter kits, (MIPR R-55-525-AVD-RP), $618,150.

Cessna Aircraft Co., Wichita, Kans., L-19A airplanes for D/A, data revisions, (MIPR R-55-531-AVD-RP), $688,894.

American Machine & Metals, Inc., U. S. Gauge Div., Sellersville, Pa., gage, pressure dial indicating, 811 ea., manifold pressure, type MB-1, 782 ea., (PR 635809), $28,574.

Bendix Aviation Corp., Eclipse-Pioneer Div., Teterboro, N. J., indicator, attitude gyro, type J-8, 3080 ea. (PR PE-635839, PE 635839-1 and 598494), $1,175,040.

Bendix Aviation Corp., Eclipse-Pioneer Div., Teterboro, N. J., indicator rate offlow, type A-19, 5358 ea., (PR 635832), $167,973.

Kollsman Instrument Corp., 80-08 45th Ave., Elmhurst, N. Y., altimeter, pressure, range 0-80000 ft., 2075 ea., type MA-1 spec MIL-A-8408, Aero 60-605, (PR 673514 and 673514-1), $295,687.

Charles Beseler Co., 211 S. 18th St., East Orange, N. J., type EL-2 photo print dryer, 322 ea., (PR MO-600021 and MO-600105), $167,411.

Airpath Instrument Co., Lamberth Field, St. Louis, Mo., compass, pilot's standby, 2814 ea., Aerno 60-1447, 800 ea., (PR 673576, 673536 and 673536-1), $66,111.

Kollsman Instrument Corp., 80-08 45th Ave., Elmhurst, N. Y., indicator, rate of climb, 3945 ea., (PR 673539-1 and 2), $253,-920.

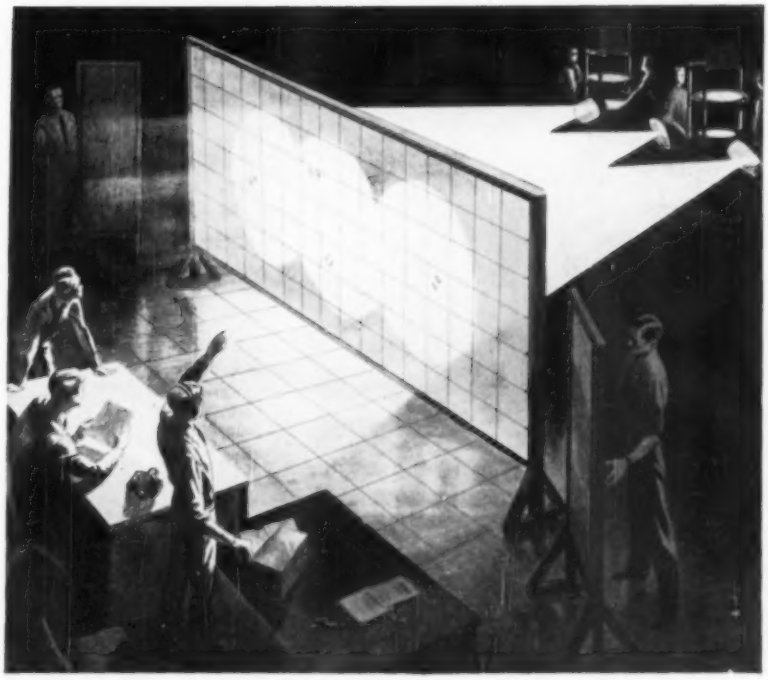
Oscar Fisher Co., Inc., 1000 North Division St., Peekskill, N. Y., jet mixer—PM-25, 50 ea., chemical storage tank MT-25, 100 ea., (MIPR R56-2404-118-AER), $25,020.

Federal Telephone and Radio Co., Div. International Telephone and Telegraph Co., 100 Kingland Rd., Clifton, N. H., transformer, 100 amp (installations), 1040 ea., transformer rectifier, 100 amp (ATRC), 20 ea., (PR 635565), $372,545.

ROME AF DEPOT, Griffis AFB, Rome, N. Y.

Albert & J. M. Anderson Mfg. Co., 289 A Street, Boston 10, Mass., cable-assy, cable conductor spec MIL-C-7974, 394 ea., (IFB 30-635-56-54B), $49,919.

The Lewis Engineering Co., 339 Church St., Naugatuck, Conn., wire-elec insul in a/w MIL-C-25038 16 AWG, 1500000 ft.; wire-elec insul in a/w MIL-C-25038 20



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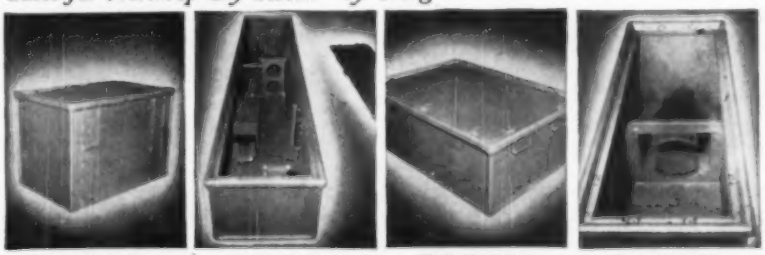

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Edison field engineers with years of aircraft experience are located in Ft. Worth, Dayton, Glendale, Chicago and West Orange. They will gladly analyze your temperature control problems and recommend action. Just write any of these offices and let us know your requirements.

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AWG, 28000 ft.; wire elec insul in a/w MIL-C-25038 8 AWG, 67000 ft.; wire-elec insul in a/w MIL-C-25038 0000 AWG, 10000 ft; wire-elec insul in a/w MIL-C-25038 4 AWG, 19000 ft, (RFP 30-635-56-4068Q), $290,186.

Teletype Corp., 4100 W. Fullerton Ave., Chicago 39, Ill., motor-AC syno type 110 V 60 cyc., 695 ea., (RFP 30-635-56-4625Q), $35,752.

Eastman Kodak Co., 343 State St., Rochester 4, N. Y., film, 32mm X 2000', MP, DRL, 6000000 ft., (RFP 30-635-56-4461Q), $75,360.

Soderberg Mfg. Co., Inc., 628 S. Palm Ave., Alhambra, Calif., lens-blue assy runway marker, 50000 ea., lens-blue lamp assy runway marker, 3000 ea., (IFB 30-635-56-53B), $146,660.

MEMPHIS AF DEPOT, Mallory AF Station, 330 Jackson Ave., Memphis 2, Tenn.

Air Products, Inc., Allentown, Pa., spare parts, RFP 40-604-56-95, 2861 ea., $45,838.

American Air Filter Co., Inc., Herman Nelson Div., Moline, Ill., pump fuel, RFP 40-604-56-102, 2064 ea., $99,072.

OGDEN AMA, Hill AFB, Utah.

Del Mar Engineering Labs, 2322 Sawtelle Blvd., Los Angeles 64, Calif., tow target, aerial, radar reflective, 100 ea., (1 item, RFP 00-543320), $48,742.

Federal Aircraft Works, Inc., 3456 North Mississippi Drive, Minneapolis, Minn., kit, modification ski bottom, 190 ea., (MIPR R-56-8342-TCSMS-03-B), $33,019.

H. W. Loud Machine Works, Inc., 969 E. 2nd St., Pomona, Calif., cylinder assy, 339 ea., Barrel-act cylinder, 2271 ea., plate identication, 20 ea., barrel-MLG door, 842 ea., valve-check hyd restrictor, 102 ea., seat valve poppet shimmy damper & power steering 2063 ea., shaft & lever assy steer damper, 1210 ea., plunger-damper steer, 1846 ea., spool & sleeve assy damper steer, 408 ea., bolt-damper steering, 1167 ea., shaft-damper steering 625 ea., plateiden, 20 ea., washer, 1268 ea., lever pneu self locking act rocket door, 210 ea., lever assy damper steering appl, F86, 1013 ea., (15 items, RFP-00-542627), $176,548.

ACF Industries, Inc., (ERCO Div.), Hyattsville, Md., modification of flight simulator (RFP-00-371105 & 00-217195), $3,344,885.

SAN ANTONIO R&D PROCUREMENT OFFICE, ARDC, P. O. Box 63, Lackland AFB, San Antonio, Texas.

The University of Rochester, Rochester, N. Y., additional work, time and funds on research and reports on a study of oxygen poisoning, (AF 18(600)-556), job, $29,955.

Educational Research Corp., Ten Craigie St., Cambridge, Mass., additional work, time and funds for development of a B-4 simulator maintenance training program outline, (AF 18(600)-1355), job, $40,368.

Psychological Research Associates, 1025 Connecticut Ave., N.W., Washington 6, D. C., research for development of standardized survival situation tests, (AF 41-(657)-65), job, $39,697.

American Institute for Research, 410 Amberson Ave., Pittsburgh 31, Pa., research for experimental investigations of transferable skills in electronic maintenance, (AF 41(657)-7), job, $40,055.

MIDDLETOWN AMA, Olmsted AFB, Middletown, Pa.

American Machine & Metals, Inc., U. S. Gauge Div., Clymer Ave., Sellersville, Pa., resease assemblies, parachute, type F-14, 28474 ea., (PR MA (598644), $1,462,139.

Avco Mfg. Corp., (Lycoming Div.), 550 Main St., Stratford, Conn., crankshaft machining and balancing assy, 1500 ea., (RFP PR MA(598742), $2,535,000.

Bendix Aviation Corp., Hamilton Div., Fifth St. & Ford Blvd., Hamilton, Ohio, overhaul and modification of model TJ-L1 Fuel controls, 250 ea., (PR MA(718768), $132,500.

DAYTON AF DEPOT, Gentile AF Station, Dayton 10, Ohio.

Sperry Rand Corp., Sperry Gyroscope Co. Div., Great Neck, L. I., N. Y., mock-up J-2 gyrosyn-Sperry T 160964, 74 ea., maint, data, revisions in a/w exhibit MSMMT No.

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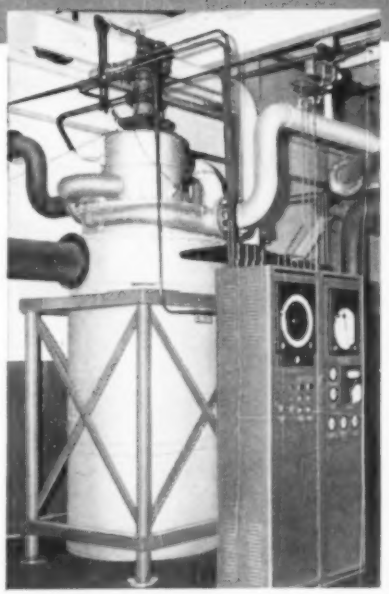

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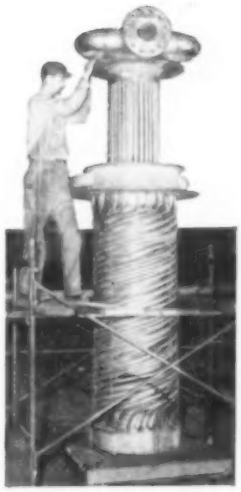

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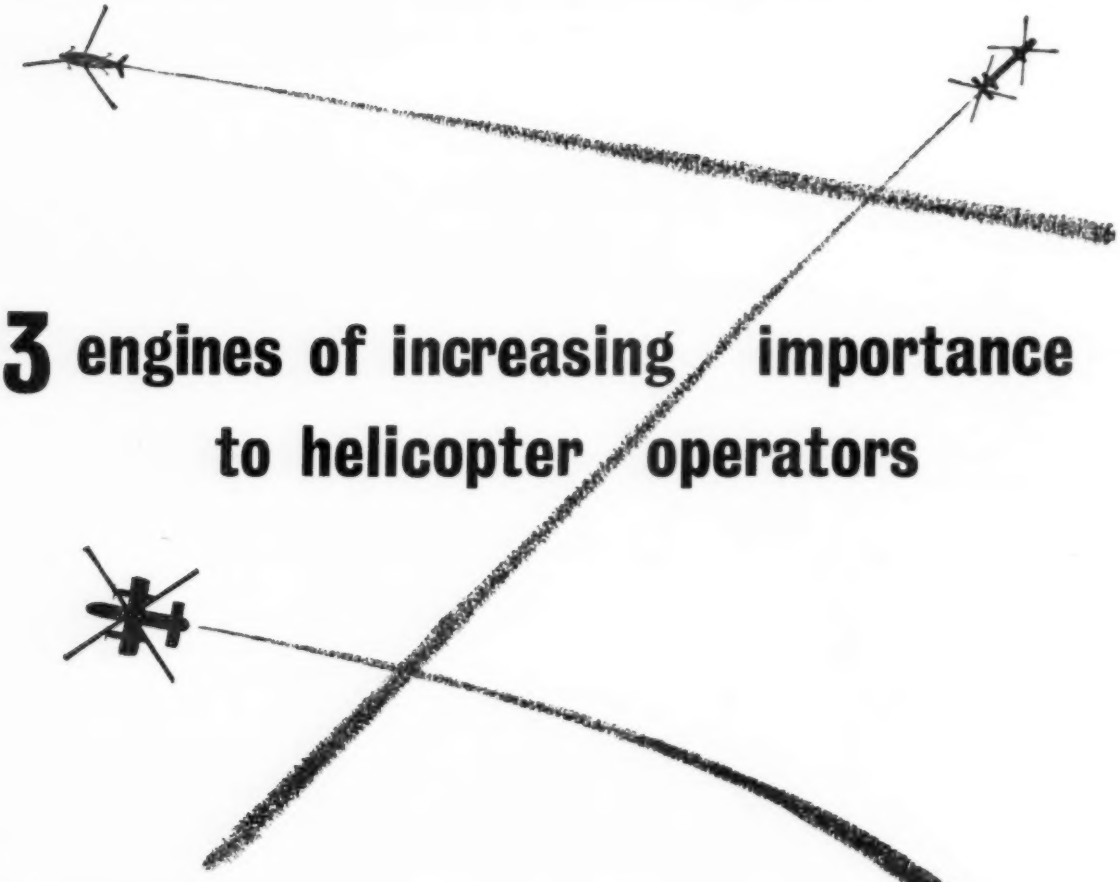

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ELAND Fairey's new large transport helicopter, the Rotodyne, is to be powered by two *Elands*—basically similar to the standard *Eland* but with an auxiliary compressor mounted co-axially at the rear. Power is taken through the auxiliary compressor (in the form of compressed air to the rotor) for vertical flight, and through the propeller for forward flight.

ORYX Two Napier *Oryx* engines have been mounted in the new Percival P74. Napier worked with Hunting Percival in the development of the *Oryx*, a 780-825 gas h.p. turbo-gas-generator which has been officially Type Tested at 780 g.h.p. This new Napier power unit eliminates all mechanical transmission.

GAZELLE This 1,260 s.h.p. Free Turbine helicopter engine is another Napier engine which is going places. Two *Gazelles* will be mounted vertically in the Bristol 192, a new twin rotor helicopter, and one *Gazelle* will power the Westland S.58 "Wessex" helicopter which is being adopted by the Royal Navy. The engines are directly connected to the rotor heads, providing mechanical transmission in its simplest form.

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CBC 225

1-16, (RFP 33-605-56-1206), $96,887.

The A. W. Haydon Co., 232 N. Elm St., Waterbury, Conn., relay-motor driven non-pile up type DC 2 Hayden #D6412, 100 ea., relay-motor driven pile up type Haydon C11487, 150 ea., relay-time delay, A.W. Haydon P/N D-6493, 100 ea., (RFP 33-604-56-1048), $34,793.

Sangamo Elec. Co., Box 7, Marion, Ill., capacitors, in a/w spec MIL-C-SA, 6 items various quantities capacitors in a/w spec MIL-C-25-A, 16 items various quantities, (IFB 33-604-56-28), $32,117.

Geo. L. Nakervis Co., Commercial Div. 20 Bartlett Ave., Detroit 3, Mich., stand assembly-fuel nozzle test, contractor's part No. 416, handbook data in a/w exhibit MCMTT No. 1-16, (RFP 33-604-56-1984), $65,386.

Standard Electrical Products Co., 2240 E. Third St., Dayton 3, Ohio, vibrator-non synchronous, oak V-6648, 1000 ea., vibrator-non synchronous, oak V-6930, 6597 ea., clamp electrical SS, Birtcher 926A, 2000 ea., clamp-electrical SS, Birtcher 926C, 1500 ea., clamp-electrical SS, Birtcher 926C39, 500 ea., clip-electrical grid plate millen, 36004, 3000 ea., clip-electrical grid plate millen 36002, 6000 ea., vibrator-non synchronous oak 6203-36KN, 50 ea., (RFP 33-604-56-1755), $41,382.

Press Wireless Laboratories, Inc., 25 Prospect Pl., West Newton 65, Mass., synchro test sets TS-713/U in a/w MIL-S-4927 (USAF), 33 ea., Technical Publications in a/w MCMTT exhibit No. 1-16, dwg and data lists requirements vandyke negatives, 1 set, blueprints, 6 sets, (RFP 33-604-56-1494), $36,976.

Airpax Products Co., Baltimore 20, Md., transformer, AF Airpax P/N AT601, 4800 ea., (RFP 33-604-56-2007), $30,240.

Collins Radio Co., 855 35th St., N.E., Cedar Rapids, Iowa., transmitter sub-assy Collins P/N 571-0361-40 appl AN/ART-13A, 1000 ea., (RFP 33-604-56-1689), $110,420.

Machlett Laboratories, Inc., 1063 Hops St., Springdale, Conn., tube, electron JAN type 2C39A in a/w MIL-E-1/56A dtd 13 Aug 56, MIL-E-1B dtd 2 May 52, Amend. No. 3 dtd 12 Nov 53, 70000 ea., (RFP 33-604-56-1871), $823,200.

The Pyle National Co., 1334 N. Kestner Ave., Chicago 51, Ill., connector recept Pyle National X 11600 PEPB, 350 ea., connector recept Pyle National X19100PEPB, 150 ea., connector recept Pyle National X192-00PEPB, 200 ea., connector receptacle Pyle Natl X19100REPB, 300 ea., connector recept Pyle Natl X11300 RLP, 200 ea., connector recept Pyle Natl X11200RLP, 260 ea., connector recept Pyle Natl X6101 -REP, 200 ea., (RFP 33-604-56-2102), $25,505.

DeJure Amsco Corp., Northern Blvd. at 45th St., Long Island City 1, N. Y., resistor var WW DeJure P/N R10.1135, 1500 ea., (RFP 33-604-56-2201), $29,475.

Radio Corp. of America, RCA Tube Div., Camden, N. J., 15 items misc coils, transformer crystal units, knobs and dials, var quantities, $86,668.

Radio Corp. of America, RCA Tube Div., Camden, N. J., 24 items misc parts for airborn radar equip; also, insulators, knobs and dials and connectors, var quantities, $25,031.

Sperry Gyroscope Co., Div. of Sperry Corp., Great Neck, L. I., N. Y., 2 items of electron tubes, 19653 ea., $47,997.

Sperry Gyroscope Co., Div. of Sperry Corp., Great Neck, L. I., N. Y., 6 items of electron tubes, var quantities, $70,920.

Collins Radio Co., 855 35th St., N.E., Cedar Rapids, Iowa., 10 items of misc parts for Airborn Radio Comm equipment, var quantities, $32,572.

Gilfillen Bros, Inc., 1815 Venice Blvd., Los Angeles 6, Calif., 28 items AF and IF transformers, coils RF, reactors, $38,616.

Norden-Ketay Corp., Precision Components Div., 555 Broadway, New York 12, N. Y., synchro-receiver Norden-Ketay P/N 105C2A (dwg C-13207), 666 ea., (PR's GE-643270, GE-643271), $34,398.

SACRAMENTO AMA, McClellan AFB, McClellan, Calif.

Lockhead Aircraft Service, Inc., 4207 Empire Ave., P. O. Box 48, Burbank, Calif., restoration of ten (10) crash damaged F-94 type aircraft, (P/R 55-1928 Contract AF04 (606)-4461), $98,314.

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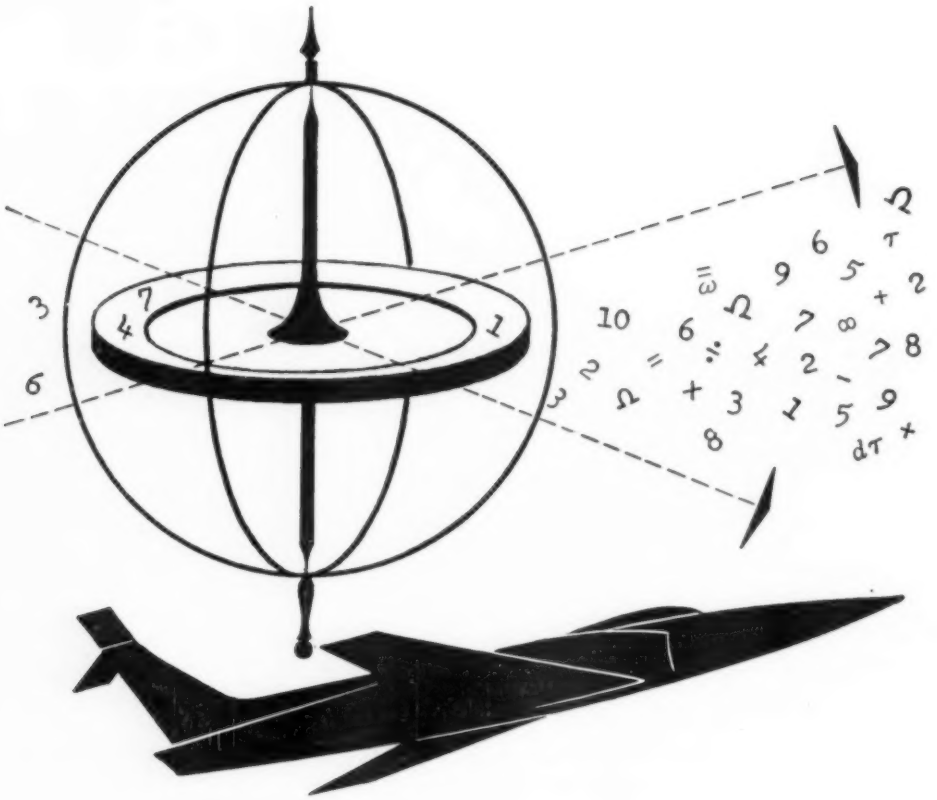

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WHO'S WHERE

(Continued from page 23)

Dr. Carlton W. Miller, assistant general division manager, Perkin-Elmer Corp., Norwalk, Conn. Also **George D. Huff,** administrative operations director and **Thomas P. Fahy,** engineering director.

A. V. Strunk, chief engineer, Longren Aircraft Co., Torrance, Calif.

Wayne Goldie, engineering and sales director, Pastushin Industries, Inc., Los Angeles, Calif.

Stan F. Erbeck, project manager-supersonic jet trainer program, Northrop Aircraft, Inc., Hawthorne, Calif. Also: **John Couberly** and **Harry Parker,** project manager assistants.

D. S. Stewart, manager-Britannia production, Bristol Aircraft, Ltd., Bristol, England. He succeeds **F. J. Chard,** who has taken up a new Defence Programme project appointment.

Dr. Dimitry E. Olshevsky, head-Inertial Systems Research Laboratory, Guided Missiles Division, Fairchild Engine and Airplane Corp., Wyandanch, L. I., N. Y.

William E. Diefenderfer, assistant chief engineer, **Ermano Garaventa,** assistant factory manager, and **Thomas B. Rhines,** assistant chief engineer, named to the operating committee, Hamilton Standard, Division of United Aircraft Corp., Windsor Locks, Conn.

Omer Willing, deputy to **William B. Davis,** Director of the Office of Aviation Safety, CAA. Also: **Ward B. Madsen,** chief-Air Carrier Safety Division; **Burleigh Putnam,** chief-General Safety Division; and **George H. Weitz,** deputy to Mr. Putnam.

Russell K. Rourke, director-engineering research, and **Norman R. Parmet,** director-aircraft development, Trans World Airlines.

Reuben P. Snodgrass, director-flight research, Sperry Gyroscope Co., Division of Sperry Rand Corp., Great Neck, N. Y. He succeeds **Robert B. Roe,** now facility planning manager, Sperry Rand's new aviation division (Phoenix, Ariz.).

David H. Holladay, (faculty) aviation safety training division, University of Southern California, Los Angeles, Calif.

Geoffrey De Meiss, general manager-European and Middle Eastern Divisions (Zurich, Switzerland), Babb Company, Inc., Phoenix, Ariz.

Arthur C. Cotss, William H. Ashley, Jr., John B. Loser, II, Joseph W. Gunther, and **Bruce F. Miller,** engineering staff, Midwest Research Institute, Kansas City, Mo.

C. E. Gumbert, Jr., chief engineer, Elbeeco, Inc., subsidiary of Aeroquip Corp., Jackson, Mich. Also: **Mathias A. Gatzweiler,** production control manager.

Sol Schneiderman, senior project engineer, Radio Receptor Co., Inc., Brooklyn, N. Y.

Donald E. Davidson, West Coast manager (Burbank, Calif.), Bendix International Division, Bendix Aviation Corporation, New York, N. Y.

Capt. Gerald D. Linke, USN (Ret.), head-materials section, Turbo Division of American Machine & Foundry Co., New York, N. Y.

John T. Burns, western region manager-aircraft products sales (El Segundo, Calif.), Vickers, Inc., Detroit, Mich.

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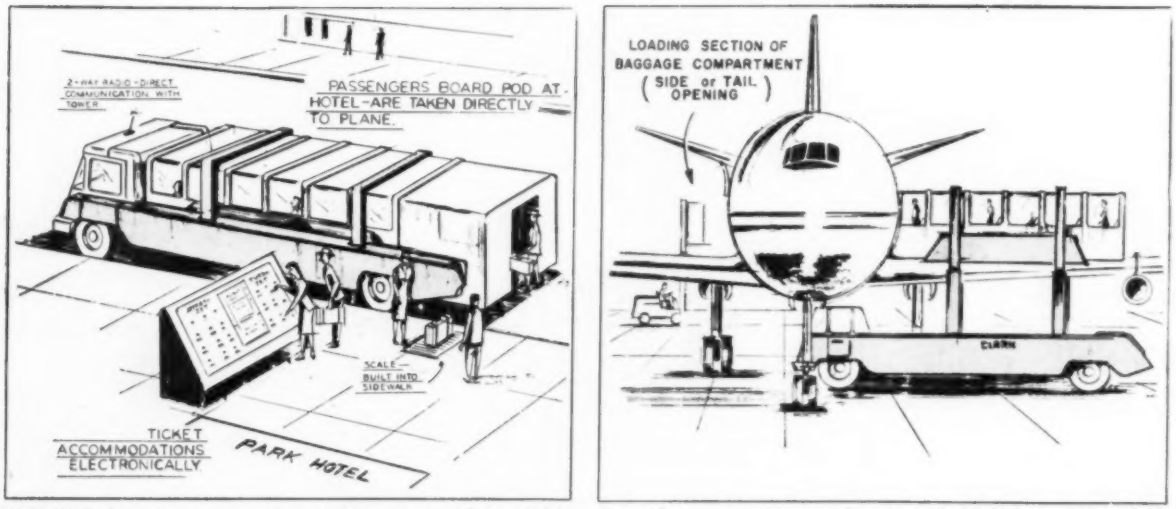
2-WAY RADIO-DIRECT COMMUNICATION WITH TOWER
PASSENGERS BOARD POD AT HOTEL-ARE TAKEN DIRECTLY TO PLANE.
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CLARK

SKETCHES show passenger-carrying straddle carrier and detachable pod boarding passengers at a downtown hotel (left) and disembarking them at the plane from raised pod (right). Plan, proposed by Clark Equipment, also calls for electronic ticketing and sidewalk scales.

Jet Age Ground-Handling Problems

Air Transport Seminar recommends keeping planes away from terminals; moving cargo, passengers.

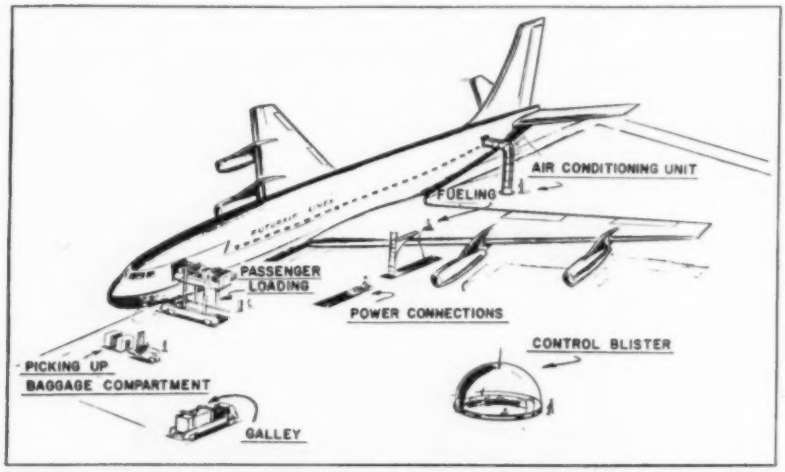
By George L. Christian

Battle Creek—The inauguration of jet air transports late in this decade is expected to swamp the presently overburdened ground-handling facilities of most airports and airlines.

Along with the multitudes of other problems which jet operations are bringing them, airport managers are beginning to consider new handling methods and equipment.

Most accept the suggestion that a systems approach must be applied to ground-handling. Only in such an integrated system can the maximum use be made of labor-saving and time-saving mechanical equipment.

Among the advocates of the systems approach is the Clark Equipment Co., manufacturer of materials handling equipment, which recently sponsored an Air Transport Seminar here. Major airlines, airframe manufacturers, airport managers and the Civil Aeronautics Administration participated.



DECENTRALIZED air terminal position has maximum number of facilities underground (air conditioning, fueling) and minimum amount of ramp vehicles to speed ground handling.

An economical system for handling the jet transports, their passengers and cargo, according to studies by Clark Equipment, must:

- **Keep planes** away from terminals.
- **Move passengers** and cargo to the plane instead of vice versa.
- **Keep passengers** and baggage together.
- **Integrate jets** and piston-engine planes and their ground-handling at the same terminal.
- **Provide means** of passenger transfer on interline connections without running them through the terminal. Also, make it possible for passengers coming from downtown to bypass the terminal and go straight to their planes.
- **Handle all-cargo** flights from separate freight terminals.

Clark engineers divide a ground handling system into five parts: aircraft, aircraft service, airport and terminal, passengers and baggage, and cargo and mail. The seminar considered each of the categories and considered the suggestions outlined by the company.

- **Aircraft.** The high capital cost of the jet liners requires the cutting of non-revenue producing ground time to the minimum. To this end, the aircraft design must fit the "system." Clark suggests that cargo and baggage areas should accommodate preloaded containers and the plane should have built-in power sources for engine-starting, air conditioning, hydraulics and other auxiliary requirements. The participant committee, with Ralph G. Lohmann of the Martin Co. as chairman, considered the concept that handling begins in the airframe design practical, and recom-

mended a study of aircraft using major terminals.

• **Aircraft servicing.** A committee, under David Goodall of Eastern Air Lines, stated that one cardinal principle of a jet airliner operation will be that its engines run as little as possible on the ground. They divide airport servicing into two types: originating and terminating stations and enroute stations.

The large number of aircraft which must be handled at the originating and terminating points makes a decentralized airport system most desirable in the committee's opinion. At en route stations, however, today's terminal area servicing probably would be best.

In both situations, hydrant or pit refueling may be essential. Clark Equipment suggested that it did not seem practical to plan on trucking fuel where 20,000 gal. per airplane may be required. (Clark noted that scheduled airlines will use 1,154,000,000 gal. of fuel this year, and estimated consumption would rise to 2,462,100,000 in 1960 and 3,000,000,000 in 1962.)

The committee accepted the suggestion that galleys should be removable for easy servicing but rejected removable lavatories. These would require additional structure and increase weight.

Tow tugs for jet aircraft probably will be equipped with A.C. generating equipment.

Ground Time

• **Airport and terminal.** The time-economics equation for the $4.5 million-dollar airplane, according to the committee under Marvin Whitlock of American Airlines will dictate a ground-time of 12 to 15 min. on through flights and 20 to 30 min. on turn-around flights. Central terminals were considered likely to be best for most cities and especially those having a high schedule of interline connections.

Those cities with low rates of interline connections—such as New York International and Miami airports—could use decentralized terminals.

This committee considered the jet fuel problems and expected that major airports would require refinery to airport pipeline service.

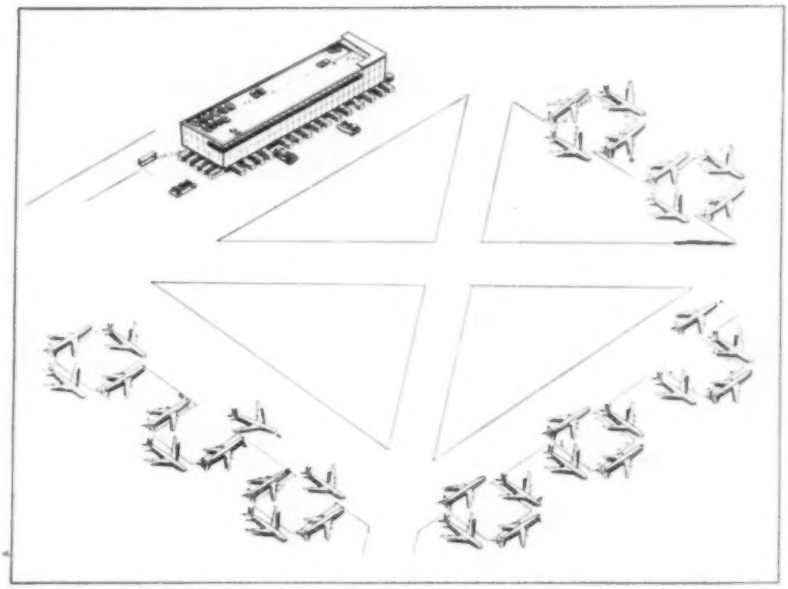
Underground installation of servicing equipment at aircraft spotting positions was considered essential to decrease vehicle mounted equipment.

Clark proposed that passengers be brought directly to aircraft from the airport terminal building or from downtown terminals in special carriers. The proposal is for a bus-like pod which could be picked up by a straddle carrier.

At the aircraft, the pod would be raised to the level of the aircraft entrance.

The pod-carrier combination could be used to transfer passengers directly from one aircraft to a connecting flight. This would eliminate the exasperating trek into a terminal and out again.

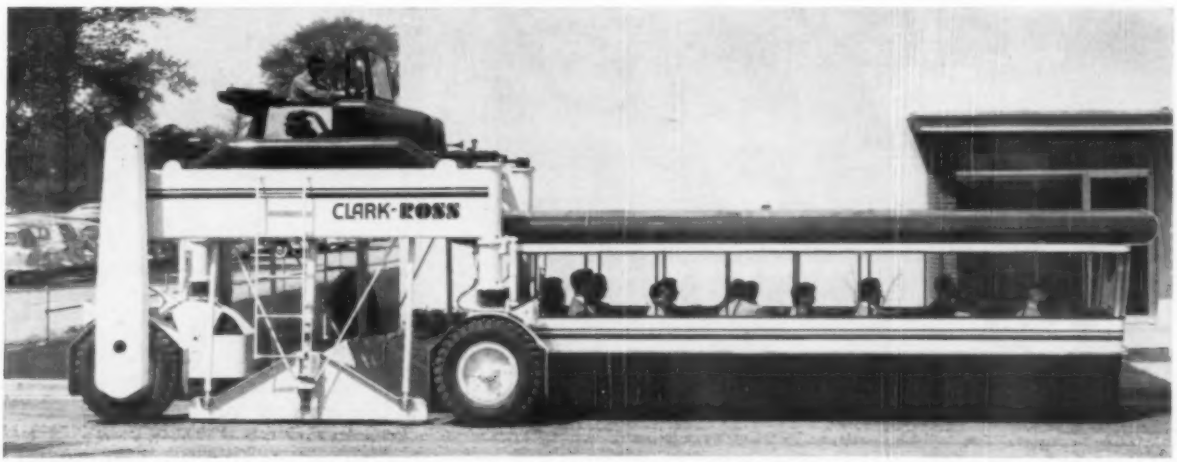
Advantages cited for this arrangement are a decrease in size of terminal ramp areas and reduction in noise through the disperson of aircraft at points remote from the terminal center.



FOUR planes per position at proposed decentralized airport allows for much smaller terminal building. Passengers are taken to planes in the straddle carriers and passenger pods.

Buses Cheaper

• **Passengers and baggage.** This committee thought buses would be cheaper than straddle carriers for over-the-road movement of passengers. Pods could be used on the airport premises for transfer of passengers from terminal to aircraft and for lifting bus-delivered patrons at plane-side. The committee, whose chairman was William F. Prigge of American Airlines, concluded that



SHOWN is 16-passenger pod built experimentally for Clark. Lumber loader toted pod with Seminar members through Battle Creek.

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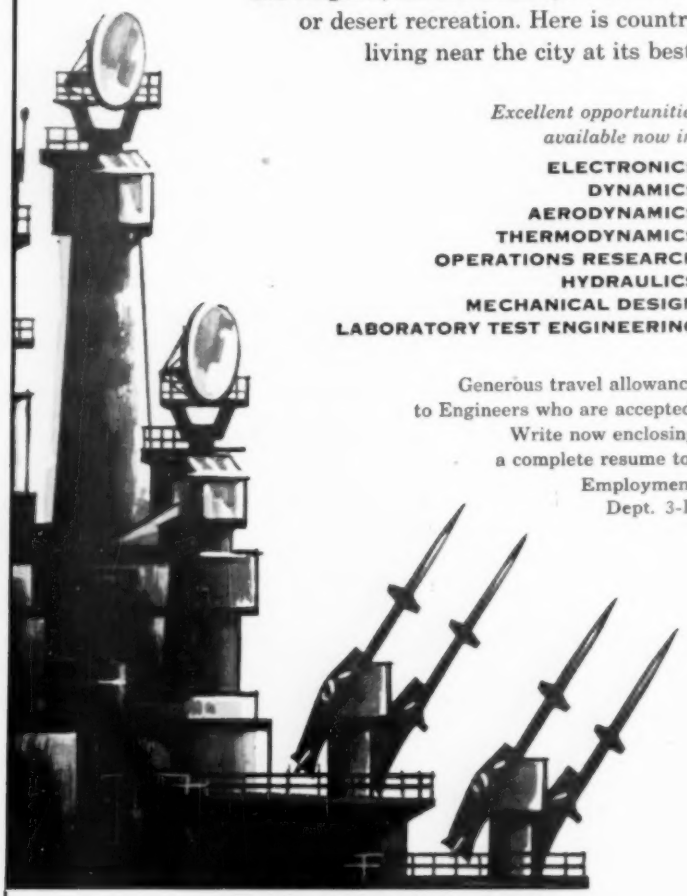

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servicing at points remote from the terminal would result in financial savings of some magnitude.

Clark suggested two pods: a 60-seat unit to serve the 707 and DC-8 and a 32 or 44-seat pod for the Electra, Viscount and Skylark.

Clark suggested consideration of a revision of baggage handling. Checked baggage might go free, but not necessarily on the same aircraft.

• **Cargo and mail.** Elimination of floors in cargo aircraft was suggested by a committee with W. F. Kalmbach, Lockheed Aircraft Corp., as chairman. Instead, tracks or rails could be installed on which the freight or cargo container would be fastened. Weight could be saved, since the container would provide its own floor.

Pre-packaged containers would be moved into and removed from an aircraft in the minimum time, according to the committee. Also, the containers could be transferred for trans-shipment from aircraft to aircraft with the least difficulty.

The floorless concept was considered valid only for non-pressurized air-freighters by one member. Fuselage, rather than container, would be the only practicable pressure vessel in his opinion. The containers would receive too rough handling on the ground to stand-up to the pressurization requirements.

Large van-type containers—three or four of which might make one plane load—were considered possibly practicable in the future. Unloading and loading operations should not take longer than the refueling of the aircraft.

Clark Equipment recommended that floor-loadings in all-cargo aircraft

should go as high as 300 lb. sq. ft. This would accommodate lift trucks used to handle the pre-loaded containers.

R. H. Davies, vice president and general manager of Clark Equipment's Industrial Truck Division and host at the seminar, announced that he expected to convene another seminar on the jet-handling problems by the end of the year. Nearly 30 people from the aviation industry participated in the first sessions.

Mobile Control Tower Is Housed in Trailer

A two-man mobile control tower now in production for the Air Force can be flown or trucked into forward areas and quickly set up to perform the functions of a permanent airport installation. Self-contained except for primary power, the unit is housed in a trailer 13 ft. long, 8 ft. wide and 7 ft. high.

A retractable observation dome, fitted with special glass panels to resist fogging and icing, provides 360-deg. visibility for the operator. The 8,300-lb. unit is air-conditioned and equipped with a collector to remove atomic and other contaminations from the air.

Radio transmitters and receivers on UHF and VHF frequencies can be operated locally, or transmitters can be operated remotely. Other equipment in the mobile tower includes telephone facilities and navigational aids.

The unit was developed and is manufactured by Craig Systems, Inc., Danvers, Mass., and is an element of "Project Four-Wheels," a mobile communications and navigation system sponsored by the Airways and Air Communications Service and the Rome Air Development Center.

Miniature TV Camera To Aid Electra Tests

A miniature television camera has been developed by Lockheed Aircraft Corp. for flight test and laboratory service.

Major assignment will be in the flight test program for the Lockheed Electra turboprop.

The camera weighs only 1¼ lb., measures 1¾ x 2 x 5 in. It is designed to operate in temperatures up to 185F and is ruggedized to withstand severe forces imposed by flight tests.

With the remotely controlled television camera, flight test engineers will be able to view operations that otherwise would be impossible to see. Viewing would be on a 27-in. screen inside the airplane.

According to Lockheed, television will play an important role in both structural and environmental testing of the Electra.

The company expects to use the camera in static tests, pressure tests of fuselage and windows, or anywhere it would be dangerous to put a man for close observation.

Development testing of the Electra is already under way in the laboratory. The television camera permits a close view, at a safe distance, of tests on wing and fuselage panels.

The miniature device has been used

MOBILE control tower has retractable observation dome, anti-fogging, anti-icing glass.

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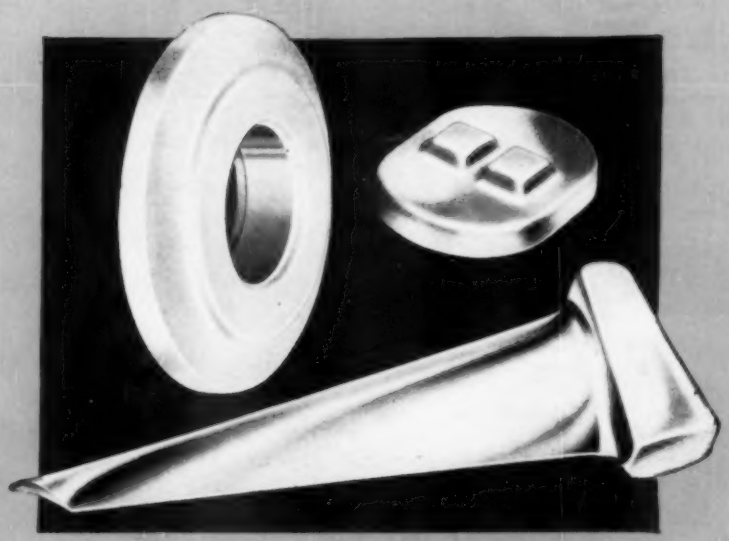

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in connection with thermal structural tests on a high speed wing section. The camera observed the wing section through a tiny window of special protective glass in the oven. Windows large enough for direct observation would have upset the heat balance, Lockheed reports.

Mounted on a toy-sized dolly with a floodlight, the minature camera can be wheeled through the inlet ducts of Lockheed's F-104 and back to the plenum chamber to inspect the otherwise inaccessible area for foreign objects which might be sucked into the engine.

Important uses of television are illustrated by what Lockheed's Georgia Division is doing with this viewing method. Static tests have been conducted with a television camera mounted inside a C-130 wing so that engineers could study the reaction of the internal structure as loads were applied to simulate various flight conditions.

A television camera in a waterproof case has been mounted in a submerged C-130 fuselage undergoing hydrostatic tests in order that evidence of fatigue failure might be observed.

Canadair Delivers Jets to Colombia

Six new Sabre VI jet fighters were delivered to the Colombian Air Force recently within a month of the South American country's order being placed with Canadair Ltd. of Montreal.

The jets flew the 3,000 miles in formation from Montreal to Bogota down the Eastern Seaboard of the United States and across the Caribbean with Colombian pilots at the controls.

Escorting them were a C-54 belonging to Colombia and a C-47 of the USAF.

Within a month, Canadair completed production on the planes, they were formally accepted by Colombia, and Canadair trained pilots and maintenance crews to handle them.

J. Geoffrey Notman, Canadair's president, was host at a farewell ceremony before takeoff which included 13 Colombian officers, attaches from the republic's embassy in Washington and three USAF officers.

Britannia Less Noisy Than Piston Planes

The Bristol Britannia, powered by four Bristol Proteus turboprop engines, makes less noise during takeoff (measured from the end of the takeoff runway) than many contemporary, piston-engine transports.

During a recent visit of a Britannia to Bromma Airport, Stockholm, the Royal Swedish Civil Air Board took noise level measurements of several different types of transports, including the Britannia, taking off. Equipment used was a Dawe Instruments Ltd. sound level meter, type 1700B.

On two takeoffs, the Britannia gave decibel readings of 83 and 81 respectively.

The latter reading was lower than any of the five other types of transports measured during the test with the exception of an ancient, three-engine Junkers 52 which tied the Britannia with an 81 db. score.

Reason for the Britannia's low ground noise level was its high rate of climb. The plane was making demonstration flights and the pilot was using maximum rate of climb. Under normal passenger operations, with a plane weighing considerably more than this particular ship probably weighed, the takeoffs would presumably be less steep, the Swedes suggest.

Other aircraft whose takeoff sound level was measured during the same test include: DC-6Bs, the noisest, with levels ranging from 116 to 100 db.; a Russian IL-12, which chalked up a level of 105 db.; two DC-3s with 88 and 94 db. respectively; and several Lodestars which ranged from 82 to 102 db.

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Applications will be accepted until further notice.

WHAT'S NEW

Telling the Market

Specifications and service recommendations of **products for aircraft**, bulletin, Packing Division, Raybestos-Manhattan, Inc., Passaic, N. J. . . . Descriptions and illustrations of **Liquid Spring Shoks**, Catalog SS, Taylor Devices, Inc., 188 Main St., North Tonawanda, N. Y. . . . Specifications and use of Surfa-Aero-Sealz to **protect airfield pavements**, booklet, Lotol and Latex Sales Dept., Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn. . . . Construction data, drawings, etc. on Renco-Aire **automation package**, specification sheet, Renco-Toledo, Inc., 819 North Reynolds Rd., Toledo 7, O.

Design features, construction and applications of **straight-through pneumatic disconnect**, specification sheet, Eastern Aircraft Products Corp., 229 River St., Orange, N. J. . . . Data sheet P108 on **subminiature door interlock switch** and data sheet 109 on **electrical memory toggle switch**, Micro Switch, Division of Minneapolis-Honeywell Regulator Co., Freeport, Ill. . . . Operating principle and procedure of **TC-2A temperature test chamber**, bulletin, Statham Development Corp., 12411 West Olympic Blvd., Los Angeles 64, Calif.

Presentation of Arga **expanded scale 400-cycle frequency meters** for panel mounting, bulletin, Arga Division of Beckman Instruments, Inc., 220 Pasadena Ave., South Pasadena, Calif. . . . Operation, uses, optional features, etc., of **single and double solenoid Speed King valves**, Bulletin SK356, Valvair

Corp., 454 Morgan Ave., Akron 11, Ohio. . . . Official U.S. Government specifications for a variety of **adhesives, coatings and sealers**, folder, Adhesives and Coatings Division, Minnesota Mining & Manufacturing Co., 423 Piquette Ave., Detroit 2, Mich. . . . Information for applying **cemented oxide tool materials**, technical report GTO-103, Carboloy Department of General Electric Co., Detroit 32, Mich.

Resistance Welding at Work, Vol. 4-#8, regarding Grumman's F9F-8 Cougar case history, Dpt. L-7, Sciaky Bros., Inc., 4915 West 67th St., Chicago, Ill. . . . Tips and Trends, booklets, for design, specification and selection of **environmental test chambers**, Conrad, Inc., Subsidiary of Crampton Mfg. Co., 141 Jefferson St., Holland, Mich. . . . Brochure of **special and standard hydraulic valves** for airborne application, Bulletin A-5209, Vickers, Inc., 1400 Oakman Blvd., Detroit 32, Mich.

Engineering data on **adhesives for honeycomb structures**, technical bulletin, Adhesives & Coating Division, Minnesota Mining & Manufacturing Co., 423 Piquette Ave., Detroit 2, Mich. . . . Illustrated information on **bonding of rubber and silicone to metal**, Apcotite Brochure, Sales Promotion Dept., Acushnet Process Co., New Bedford, Mass. . . . Technical data and operation of **frequency limit indicators**, bulletin, Arga Division of Beckman Instruments, Inc., 220 Pasadena Ave., South Pasadena, Calif. . . . Special features and illustrations of **double-action straight-side presses** ranging from 200-ton to 2,000-ton capacity, catalog, Danly Machine Specialties, Inc., 2100 South Laramie Ave., Chicago 50, Ill.

Information on range of **swivel couplings** and typical swivel connections, leaflet, Technical Publications Dept., Electro-Hydraulics, Ltd., Liverpool Rd., Warrington, England. . . . Casting Aluminum covering **design and production of aluminum castings**, technical handbook, Reynolds Metals Co., Desk PR4810, 2500 South Third St., Louisville 1, Ky. . . . Description and illustration of **Type SPT 1 spot welder** and **EPT 1 projection welder**, Bulletin 335-1, Sciaky Bros., Inc., 4915 West 67th St., Chicago, Ill. . . . . Application procedures and ordering instructions for **aircraft lockbolts**, Bulletin TCL-111, Townsend Co., Cherry Rivet Division, P. O. Box 2157-Z, Santa Ana, Calif. . . . Characteristics, construction details and specifications of Series 7000 12-position **sub-miniature rotary switch**, engineering data sheet, International Instruments, Inc., New Haven, Conn. . . . Illustrated description and part numbers of **thermocouple accessories**, Engineering Bulletin No. 1610-A, Revere Corporation of America, Wallingford, Conn.

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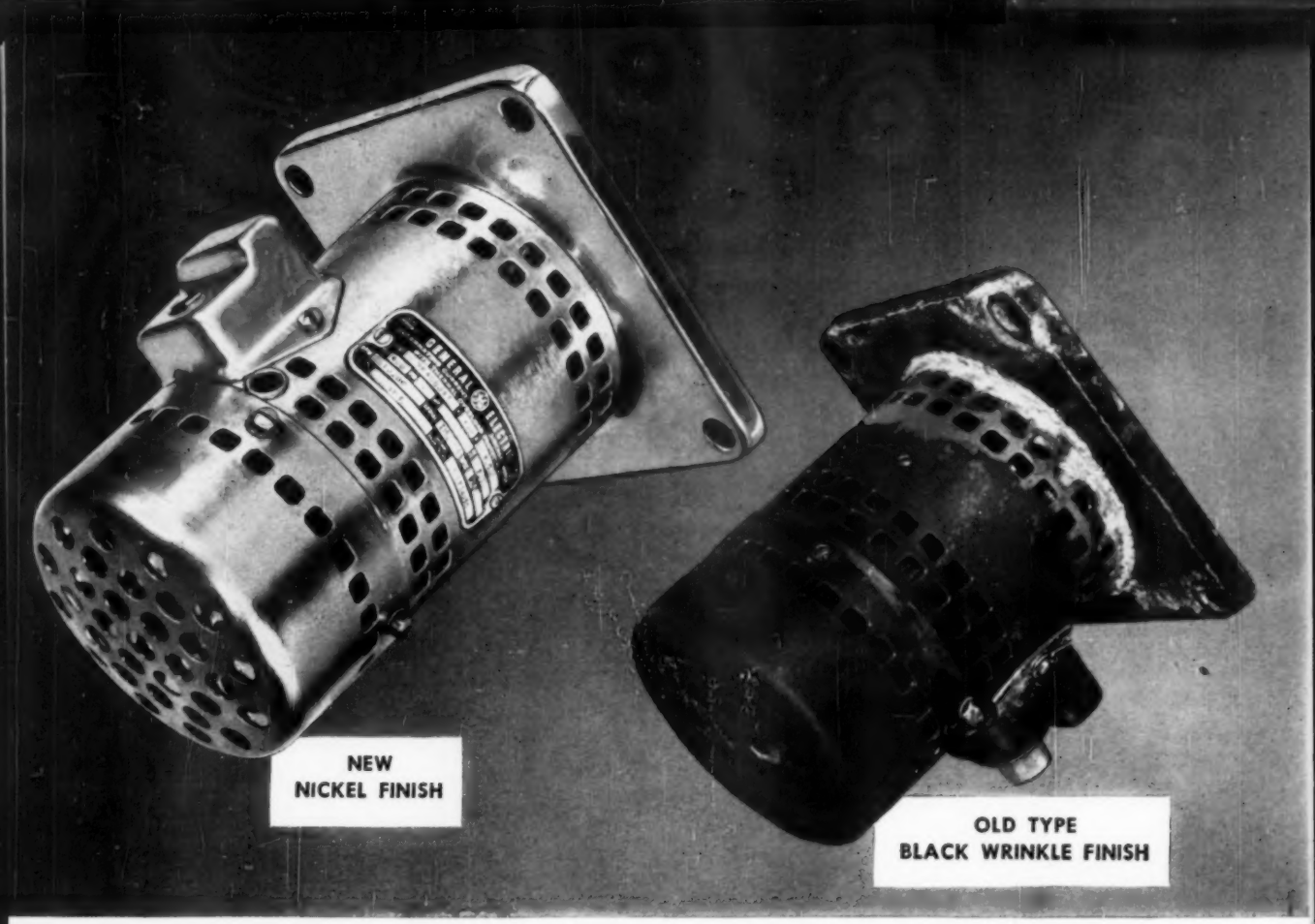

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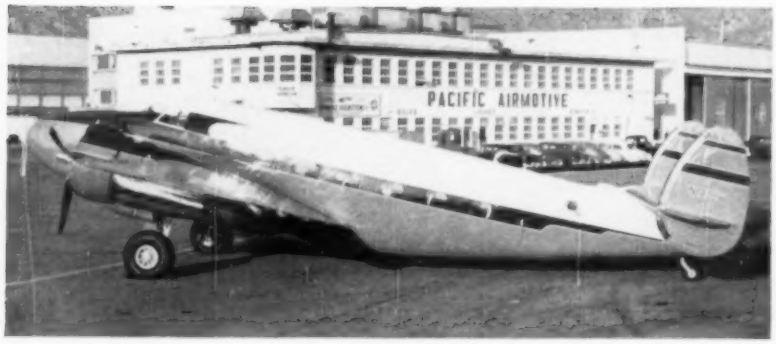
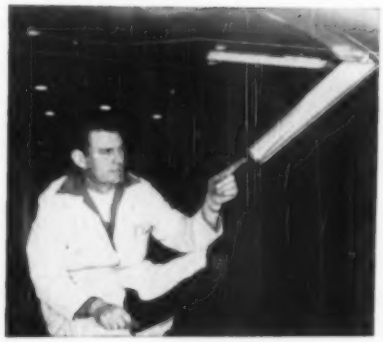




Lodestar Restyled for J&L Steel

Jones & Laughlin Steel Corp. executive Lockheed Lodestar arrived at Pacific Airmotive Corp., Burbank, Calif., conversion shops on a one-time ferry permit, the plane being non-operational, the cabin bare. Among the numerous improvements worked into the transport by PAC was a flush-mounted retractable fuel dump shute (extended and retracted, photos at right). Chute will empty two 172-gal. tanks in about seven minutes the dump valve remaining inactive until the tube is fully extended and locked. Other changes included enlarging the standard Lodestar door and making the bottom sill flush with the floor (bottom left). A comfortable working area was installed in the cabin following initial sound-proofing with a one-eighth in. sprayed-on coating of Minnesota Mining sound deadener, covering this with a four-inch blanket of fibrous glass. A complete oxygen system has the bottles under a divan. There is an outside filler for the containers so that they don't have to be removed. A 200,000-Btu. heater is placed in the tail with the air inlet atop the fuselage just ahead of the stabilizer.

THE NET

America's most potent protective weapon has been announced by the Army.

It is the new Martin Missile Master, the country's first electronic system designed to coordinate and control an integrated network of radar surveillance, target detection and anti-aircraft missile battery operation.

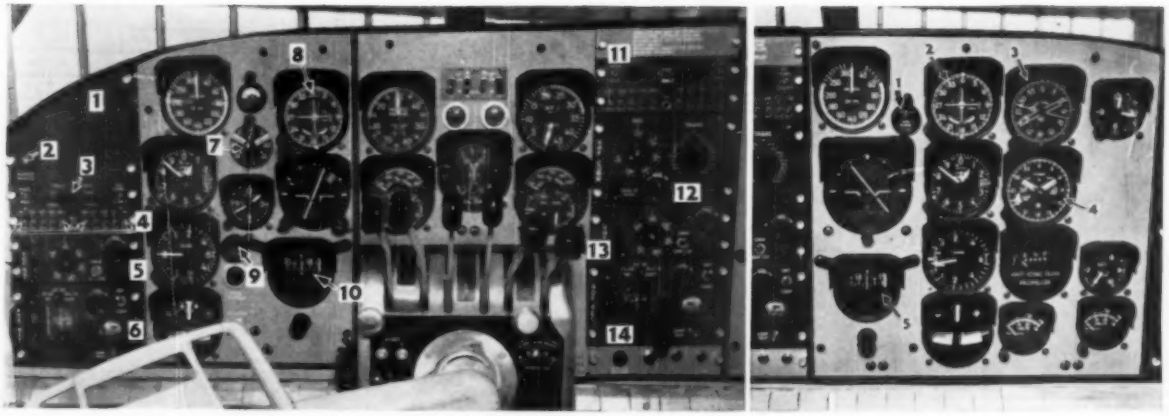
Now fully proved out and ready for installation, Missile Master offers pushbutton protection for whole cities and strategic areas.

The system collects information on the position, identity and flight data of all aircraft entering the network. This data is stored electronically and distributed to display consoles in the Operation Center and at the missile batteries.

Thus, the activity of Nike batteries and other advanced weapons in the system are centrally coordinated and controlled.

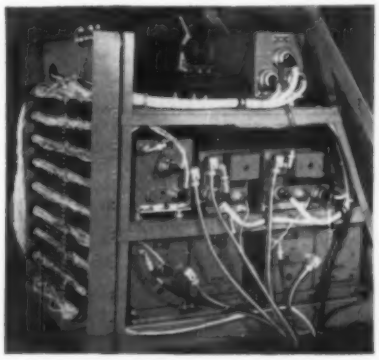
This important new weapon system is one of the great defense developments of our time.

MARTIN



ARC Outfits Twin-Bonanza as 'Flying Showcase'

Aircraft Radio Corp., Boonton, N. J., has extensively modified the interior of its new Beech C-50 Twin-Bonanza as a flying showcase to demonstrate its radio and navigation equipment to prospects and distributors (AW June 23, p. 65). Installation uses currently 5¼-in edge lighted console panels specified by U. S. military services. At the left is the pilot's equipment: 1. Space for communications set No. 1; 2. marker beacon; 3. glide slope; 4. audio selector; 5. omni No. 1; 6. ADF No. 1; course director switch; 8. omni course selector; 9. gyroslaving meter; 10. slaved gyro No. 1. On the right of the engine pedestal are: 11. co-pilot's audio control panel; 12. VHF communications set No. 2; 13. omni No. 2; ADF No. 2. In photo at right is the presentation for customer: 1. slaved gyro No. 2 indicator; 2. omni No. 2; 3. dual ADF; 4. course director No. 2, and 5. slaved gyro No. 2. To the right of this panel is a blank panel used for installation of new and experimental equipment. Communications and navigation equipment is housed on a rack behind rear seats (photo, lower right). Junction box (uncovered) is at the left. Dual omni installation is on the bottom shelf; one of the communications systems is on the left of the center shelf; the 10-channel isolation amplifier is on the right of the top shelf and a cabin loudspeaker to its rear.



Approved Service Centers Will Be Named by Piper

First of approximately 200 factory-certified service centers will be designated soon by Piper Aircraft Corp., Lock Haven, Pa. Requirements for the centers call for prescribed service and test equipment for handling the company's Apache, Tri-Pacer and Super Cub business planes.

Factory training of distributor and dealer service managers and maintenance personnel also will be provided by the manufacturer.

Piper is backing the program with a service school at Lock Haven, where 10 students at a time go through a week of instruction with emphasis on the twin-engine Apache's components and systems.

Service representatives from manufacturers of the plane's equipment assist in the curriculum.

Distributors were told that factory authorized service centers are a "must" in modern merchandising of business aircraft at Piper's distributor meeting last fall (AW Dec. 5, 1955, p. 52). There are now more than 600 Apaches in service.

Champion Tooled for One-a-Day Plane Output

Champion Aircraft Corp. has tooled its new plant at Osceola, Minn., for one-a-day production of three models of the former Aeronca lightplanes. May production totaled 23 Champions: 17 de luxe Travelers, 2 agricultural/utility Sky-tracs and 2 standard Champions. Almost 60% of all planes being turned out by the firm have radio installed.

Actual Champion output is 1½ plane daily and the company has a backlog of orders covering production for the next three-months.

Price range of the three models is from $3,995 for the 7EC Champion to $4,875 for the plushier Traveler, which has a range of approximately 590 mi., plus a half-hour reserve, with 28 gal. of fuel.

The company moved from Holman Field, St. Paul, Minn. to Osceola in February and began production at the new location in mid-March. Total employment is approximately 100.

PRIVATE LINES

Hiller H-12C helicopter is being used by Los Angeles Police Department for traffic control and rescue work. Three-way radio is installed for communication between helicopter, ground vehicles and headquarters. Other recent commercial Hiller sales: Fastener Corp., Chicago, Ill., for executive transportation; Heli-Condor, Bogota, Colombia,

This new integrating accelerometer is a basic component of Honeywell's inertial navigation and guidance systems. Containing an adaptation of the famous HIG gyro principle, the Honeywell accelerometer is a sensing device capable of measuring accelerations as minute as $\frac{1}{100,000}$ of gravity. It represents another step by Honeywell toward perfecting pure inertial guidance—the automatic navigation technique being developed to guide intercontinental ballistic missiles.

AERONAUTICAL DIVISION, MINNEAPOLIS-HONEYWELL

Wanted:

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MINNEAPOLIS **Honeywell**

Aeronautical Division

for exploration and survey; Alaska Coastal Airlines, Juneau, and Trans Australia Airlines, Melbourne, for investigating helicopter service potentials.

Purchase of a fleet of Cessna Model 620 four-engine pressurized executive transports is being considered by General Motors Corp., industry observers report.

Cessna 170 production has been discontinued because of overwhelming customer preference for the later Model 172 version with tricycle landing gear. The company will not include the 170 in its 1957 line.

Cessna built 5,131 170s since it introduced this model.

Flight Safety, Inc., LaGuardia Airport, N. Y., received its Link E-600 flight translator for training multi-engine business pilots in procedures and navigation (AW Feb. 21, 1955, p. 21). General configuration resembles the Convair 340, but procedures applicable to virtually any twin-engine plane may be duplicated.

McCulloch VS-57 supercharger, recently approved by Civil Aeronautics Administration for Hiller H-12B and H-12C helicopters, increases altitude and payload capabilities.

A 12C with the equipment has attained 15,000 ft.

New Aero Commander distributors: Hary von Rautenkrantz, Celle-Hanover, covering West Germany, Switzerland and Luxemburg; Babb SARL, Paris, including France and several possessions; Vest Aircraft de Mexico, S.A., Mexico City, representing most of Mexico and Aerotransportes Woolkopf, Buenos Aires, for Argentina. Appointments bring to eight the total of Aero Commander international sales agencies.

Learstar Mk. 1 11-place radar-equipped executive transport will be delivered to Upjohn Co., Kalamazoo, Mich., before the end of this year, making it the 22d Learstar to go into service since deliveries started early in 1955. The Upjohn Learstar is the company's first business airplane.

Amphibious version of de Havilland-Canada Otter with modified Edo floats built by Bristol-Canada is being flight-tested.

Andrex X-ray equipment was purchased by Aero Corp., Atlanta Airport, Ga., to provide corporations and private owners with one-day inspection of critical structures of their aircraft without need for dismantling planes.

Expansion costing over $200,000 for business and private plane hangar facilities at Metropolitan Oakland International Airport, Calif., is being evaluated by Board of Port Commissioners, who have approved an engineering study.

Plans call for building six cloverleaf hangars, each with room for four lightplanes, and a similar structure for four executive-type aircraft. General manager of the port, Dudley W. Frost, says that there is a waiting list of more than 100 plane owners in the Oakland area for additional hangar space.

Italians Produce New Lightplane

This two-place all-wood Falco F.8 private plane, now completing final approval tests, has a top speed of 211 mph. and cruises at 186 mph. It is powered by a 140-hp. Lycoming 0290-D. Four Falcos were ordered by private buyers prior to initial flight of the prototype April 25. Aviamilano Construzioni Aeronautische, Via Macedonio Melloni 70, Milan, expects to have 10 planes completed by the end of July. Price is approximately $14,000. Falco's gross weight is 1,540 lb.; weight empty is 1,012 lb. It takes off in 482 ft. and has a range of 621 miles with one-half hour fuel reserve.

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Avro's CF-100 all-weather, night and day, rocket-firing twin jet interceptor is an example of what this engineering team has done. In coast-to-coast service with the R.C.A.F. in Canada and also scheduled for NATO in Europe later this year, the CF-100 is only the beginning. Under development are concepts representing the most advanced state of the art.

You can be a useful member of Avro's progressive design team—enjoy satisfaction and experience in the most advanced phases of aviation.

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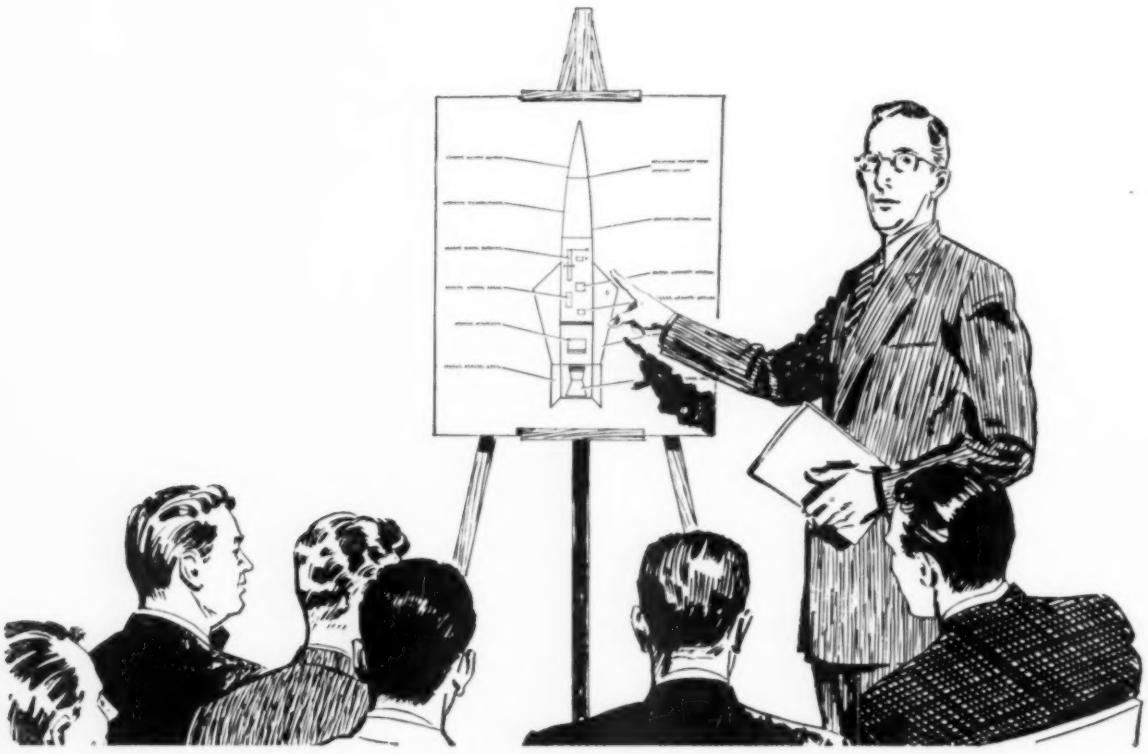
Contact: R. L. Cunningham, Missile Engineering Personnel Office
Dept. 91-20 AW, 12214 Lakewood Boulevard, Downey, Calif.

NORTH AMERICAN AVIATION, INC.



LARGE SPEED BRAKE is extended hydraulically under Cessna T-37A's nose. Cockpit canopy can be jettisoned by explosive charges.

First Production Cessna T-37A Jet Trainer Goes to ARDC

Cessna Aircraft Co. has contracts exceeding $26 million for its twin-jet side-by-side T-37A trainer, first of which has been delivered to USAF Air Research & Development Command. Chosen by ARDC following a design competition involving 15 proposals submitted by eight manufacturers, the T-37A is powered by Continental J69-T-9 turbojets delivering 920-lb. thrust each. They provide the plane with a top speed exceeding 350 mph., yet the landing speed is only 80 mph. The plane can take off or land over a 50-ft. obstacle in 2,500 ft. The T-37A has a gross weight of 6,100 lb., weighs 3,536 lb. empty. Range with 317 gal. of fuel is over 700 nautical miles plus reserve. The fuel system comprises six interconnected tanks in each wing plus a large tank behind the cockpit. Engines take fuel from the latter, which is replenished by wing tanks. All fuel management is automatic, no tank selection being required. Landing gear, wing flaps, speed brake, inlet air screens are hydraulically operated.

NOSE STRAKE increases fuselage damping to slow spin rate.

STUDENTS SIT side-by-side in Weber ejection seats.

"MISSILE WITH A MAN IN IT"

Lockheed/USAF F-104

World's Fastest Jet

The F-104 *Starfighter*, now in production for the U. S. Air Force, is the most advanced airplane of its type ever developed. *Dimensions:* height, 13 feet, 6 inches; length, 54 feet, 9 inches. *Wings:* knife-sharp, and only 7½ feet from fuselage to wingtip. *Engine:* General Electric J79, which develops more thrust per pound of engine weight than any other turbojet of comparable size. *Electronics system:* new "plug-in" type, to permit quick changes and replacements of components. *Pilot's seat:* downward firing ejection type, the first in a production jet fighter. *High, T-shaped floating tail:* twice as effective in controllability as conventional tail designs. *Armament and top speed:* both are military secrets, but the Lockheed F-104 can overtake and destroy any plane—of any size—known today.

The *Starfighter's* dart-like configuration, perfected by extensive wind-tunnel tests, permits the F-104 to flash through the sonic barrier, routinely, without a tremor. And even at supersonic speeds the *Starfighter* has unmatched ease and decisiveness of control—because never before have so many advanced design and engineering features been so superbly combined in one aircraft.

Like all Lockheed-built planes, the *Starfighter* has inherent "design flexibility" that makes it readily adaptable to a variety of military requirements—at lowest cost to our government.

Lockheed's leadership in the design and production of military planes, of nine widely different types, stems from its policy of close cooperation with the armed services. In the F-104 *Starfighter* the U. S. Air Force has the world's fastest and deadliest jet—America's "Missile With a Man in It."

Lockheed

AIRCRAFT CORPORATION

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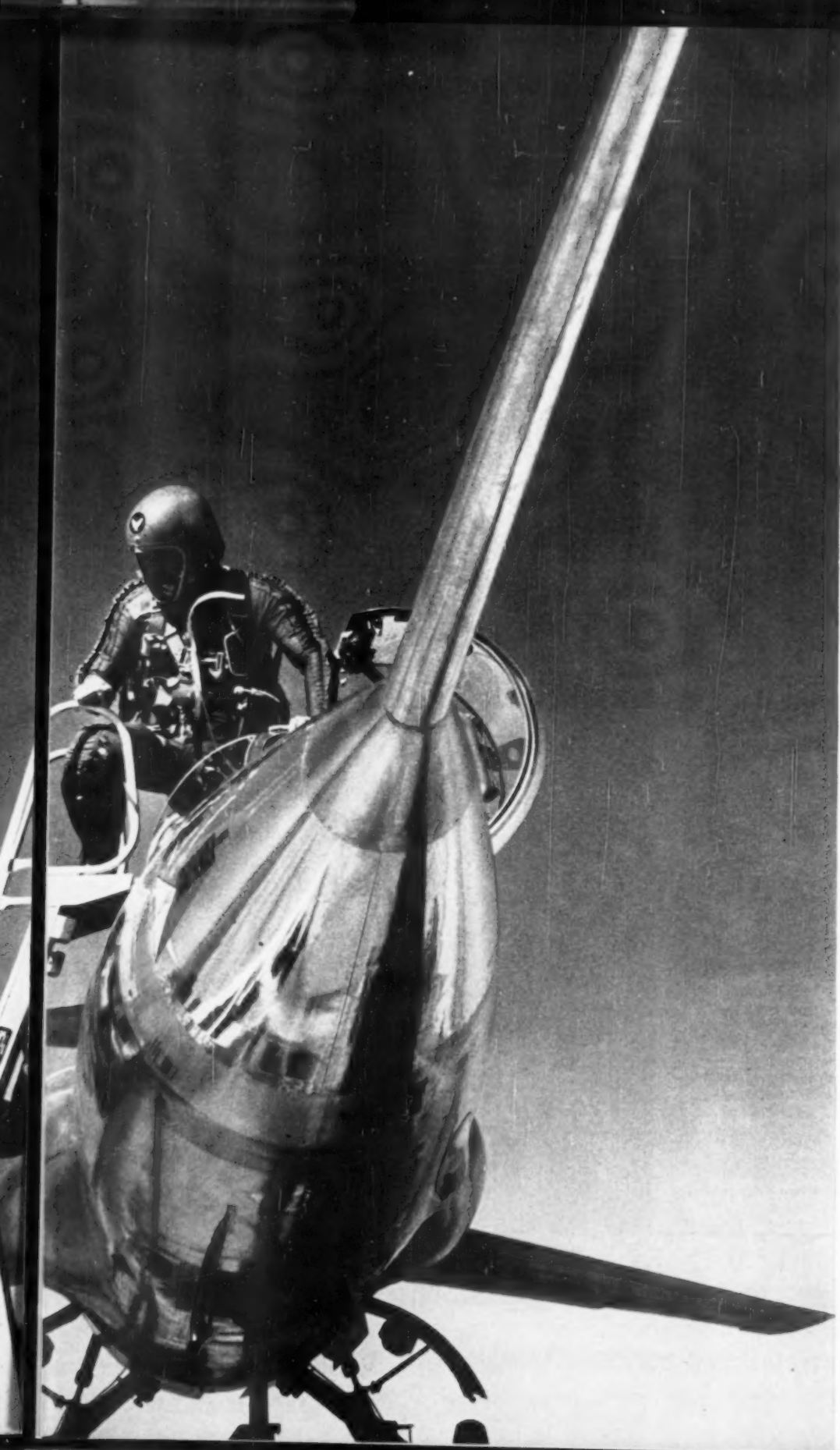
Georgia Division, Marietta, Ga.
Missile Systems Division, Van Nuys, Palo Alto and Sunnyvale, Calif.
Lockheed Air Terminal, Burbank, Calif.
Lockheed Aircraft Service, Ontario, Calif.

LOOK TO LOCKHEED FOR JET LEADERSHIP, TOO



LOCKHEED'S NEWS COLUMN

Dick Tracy has lost his lead *in the electronics race. His wrist radio is surpassed by a new "miniaturized" TV camera. Small enough to fit into a vest pocket, its "eye" is about the size of a cigarette. Built by Lockheed for research ONLY . . . (so far) . . .*

Missile Mail is promised in the foreseeable future as a civilian development of missile technology. A Lockheed official says that the thousands of scientific and technical people now researching the whole environment of man in connection with missile development will produce civilian benefits beyond the imagination of the layman today. A letter by missile, of course, would get there faster than you could write the letter in the first place . . .

A Lockheed Man is working quietly in a sanctuary abroad on a nuclear engine design that will make headlines world-wide when they take the wraps off. Same man's blueprints on a nuclear contraption so startled top military authorities very early in the nation's atomic program that they locked his patent in a government vault where, for security reasons, it still remains . . .

Lockheed has been handed *a big piece of the much-talked-about ICBMissile that will keep its Missile Systems Division scientists working nights in their new facility near Stanford University — which, incidentally,* **tripled** *in size between blueprints and ground breaking . . .*

Beating the heat which tops 250 degrees Fahrenheit at twice the speed of sound is a matter of concern now to engineers of Lockheed's California Division who are working on methods of making airplane skin glass-smooth. Even modern, high-strength dural surfaces approach their temperature limits at these speeds . . .

Early America makes atomic history this month as Lockheed Georgia Division breaks ground for its new atom-powered plane facility. The 10,000-acre North Georgia site was in the same family ever since the area opened for settlement in the 1840's.

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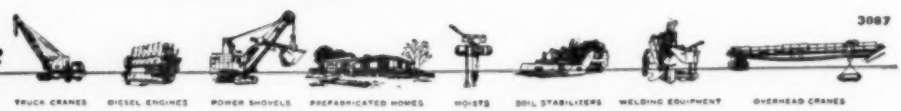

3087

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CAB Accident Investigation Report:

UAL DC-6B Explodes, Man Indicted

The Board delayed the release of this aircraft accident report at the request of the State's Attorney for Colorado, the request being prompted by the criminal aspects involved in the accident. Deemed reasonable and in the public interest, the delay was granted in accordance with the provisions of the Civil Aeronautics Act of 1938, as amended.

The Accident

On Nov. 1, 1955 at approximately 1903,[1] a midair explosion of disintegrating force occurred aboard United Air Lines Flight 629 and the aircraft, a DC-6B, N 37559, crashed near Longmont, Colo. The crew of five and 39 passengers were fatally injured. The aircraft was destroyed.

United Air Lines Flight 629 is scheduled daily between LaGuardia Field, N. Y., and Seattle, Wash. There are scheduled stops over the route at Chicago, Ill.; Denver, Colo.; and Portland, Ore., with crew changes at Chicago and Denver. On Nov. 1, 1955, this operation was routine to Denver where the flight landed at 1811, 11 minutes late because of several brief ground delays. At Denver the aircraft was refueled to 3,400 gallons of fuel and was checked for the continued flight. There was no maintenance work required or performed on the aircraft.

The Denver crew assigned for the remainder of the operation consisted of Captain Lee H. Hall, First Officer Donald A. White, Flight Engineer Samuel F. Arthur, and Stewardesses Peggy L. Peddicord and Jacqueline L. Hinds.

Captain Hall and First Officer White arrived at the airport well before flight time. Preparations for the flight were made in a normal and routine manner, and the pilots were briefed and furnished the latest weather reports and forecasts for the route. The reported weather conditions for Denver were: Ceiling measured 9,500 feet, overcast; visibility 10 miles; temperature 36; dewpoint 30; wind southwest 5 knots; altimeter 29.84. The weather conditions forecast were of little consequence but indicated the flight, as planned, would be in accordance with instrument flight rules (IFR).

Cargo Pit Emptied

When the flight arrived at Denver, the rear cargo pit (No. 4), containing cargo, luggage, and mail scheduled for Denver, was emptied and thereafter loaded with mail, freight, and passenger luggage, all of which originated at Denver. According to company records when loaded for departure the gross weight of the aircraft was 91,746 pounds which was 1,954 pounds less than the permissible gross takeoff weight. The load was properly distributed.

After a routine radio ramp check, Flight 629 taxied to runway 8R (80 degrees, right) and at 1844 the flight was in runup position where it was given ATC clearance for the flight to Portland, the first intended landing. The clearance, in part included compulsory radio reports from the flight upon passing the Denver Omni and when climbing through 18,000 feet to its assigned flight altitude, 21,000 feet. Following takeoff the flight reported its "off time" to the company as 1852 and thereafter reported passing the Denver Omni at 1856. The latter communication was the last from the flight.

Investigation

About 1903 the Denver tower controllers saw two white lights, one brighter than the other, appear in the sky north-northwest of the airport and fall to the ground. Both lights were observed 30-45 seconds and seemed to fall with approximately the same speed. There was then a momentary flash originating at or near the ground which illuminated the base of the clouds, approximately 10,000 feet above. When the controllers observed the lights they initiated action to determine if any aircraft were in distress. Radio calls were made to all aircraft in the Denver area of responsibility and all except Fight 629 were accounted for. It was soon learned that the flight had crashed and all 44 occupants had been killed.

The wreckage of the aircraft was spread along a north-northwest heading and covered an area of approximately six square miles. Within this area all the major components of the aircraft were found. The tail group was located about 4,600 feet south-southeast of two deep craters which contained large portions of both wings, the four powerplants, and main landing gear. The forward fuselage was roughly 600 ft. north of the craters and the left outer wing panel was found approximately 600 ft. south of the craters. This scatter of the heaviest and largest pieces of wreckage showed that the aircraft disintegration began in flight at an appreciable altitude and that the separation of the tail assembly occurred before separations of the wings and forward fuselage.

Aft Fuselage Torn

The aft fuselage was found to have been torn into a multitude of bits and pieces. Portions of the structure were strewn over the ground in a wide path extending south-southeast approximately four miles from the main wing wreckage, the less dense fragments being at the farther distances. Pieces of very low density material, such as paper and cabin insulation, were found as far as nine miles south-southeast. Many pieces of the aft fuselage comparable in density to the tail group were found in the area adjacent thereto. This dispersal indicates that the aft fuselage was shattered simultaneously with the separation of the tail assembly and that winds aloft carried the less dense pieces considerable distance during their fall to the ground. The severity of fragmentation indicates extremely violent shattering of this section of the airplane.

The forward fuselage from the nose rearward to a position approximately in line with the wing spar came to rest where it struck the ground. Although severely flattened by impact, the various pieces remained in their normal horizontal relationship to one another. The complete lower part of this structure was in position at the bottom of the wreckage. The fuselage nose cap bore no signs of impact; however, a small box of electric motor equipment carried as cargo and weighing 164 pounds, was imbedded in the ground directly below a hole it made upon impact through the forward cargo compartment floor. The importance of these observations was that they showed the forward fuselage assembly struck the ground with great force in an upright attitude while descending almost vertically.

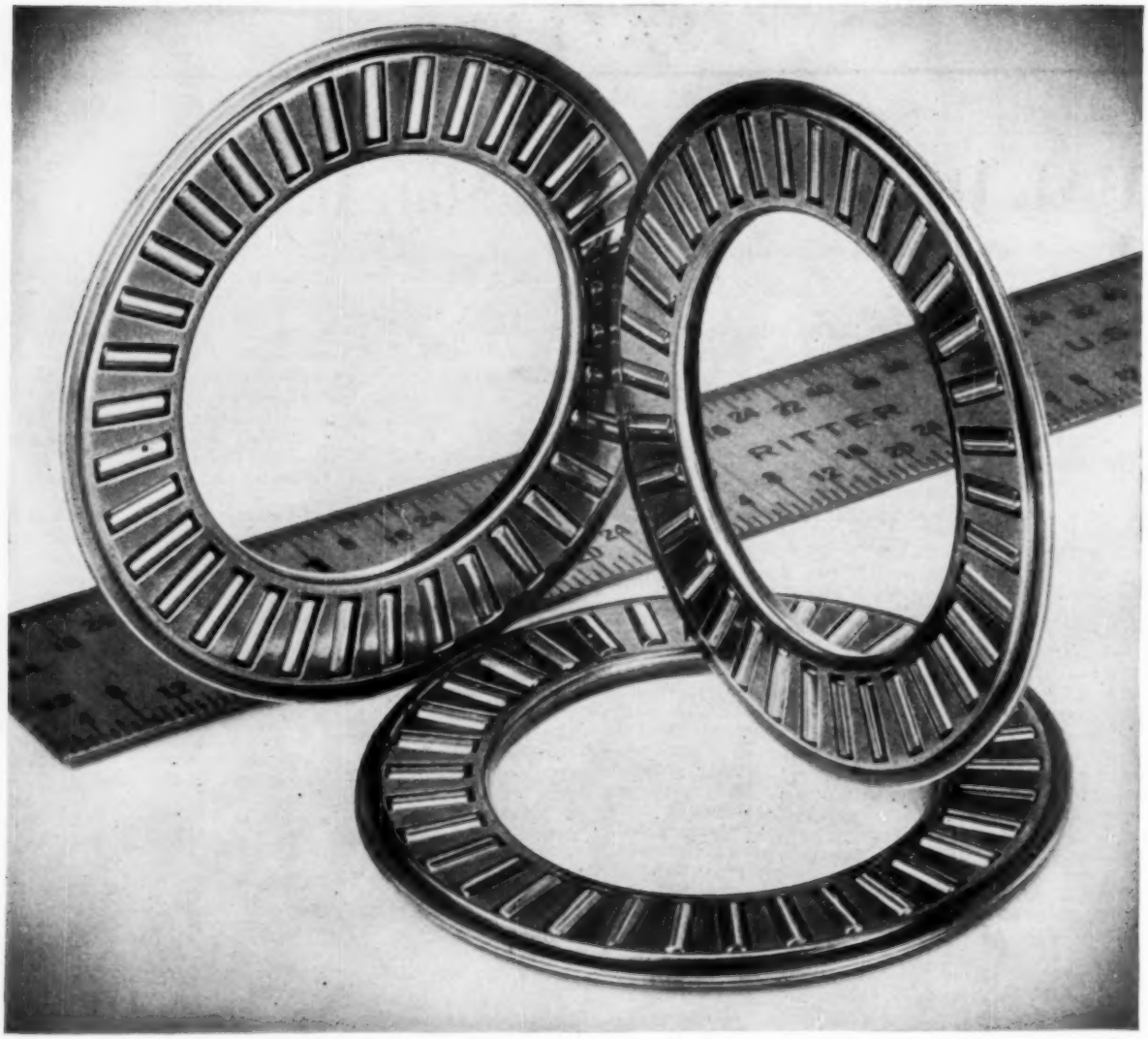
Two Craters

As previously stated major portions of the wings and center section were located in two craters, one of which was about 150 feet north of the other. In the south pit, which was about 20 feet wide, 25 feet long, and 6 feet deep, were located the Nos. 1 and 2 powerplants as well as a portion of the left wing. The north crater, somewhat longer and deeper than the other, contained the Nos. 3 and 4 engines and portions of the right wing. The depth of the craters again indicated the nearly vertical descent of the components that made them. The distance between craters showed that both wings separated from the fuselage prior to impact.

In addition to severe breakup of the structure, extensive fire damage occurred. This was due to ignition of the fuel and oil which saturated the ground in and around the craters. Despite efforts to extinguish the fires, burning continued for three days. The fire pattern in all cases clearly established that the fires occurred following impact.

At an early phase of the Civil Aeronautics Board's investigation its investigators became aware that an explosion had occurred aboard this flight while at an altitude of several thousand feet above the ground. It was also clear that the explosion was of such great intensity that it would be unusual for it to have been caused by any system or component of the aircraft. This awareness was strengthened by smudge marks and odor characteristic of an explosive

[1] All times herein are mountain standard and based on the 24-hour clock. Headings are magnetic and altitudes are mean sea level.



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that persisted on pieces of the fragmentized wreckage known to have been part of the fuselage structure in the area of the No. 4 baggage compartment. The marks and odor were particularly noticeable on passenger baggage, mail sacks and clothing known to have been contents of this compartment.

Pieces Transported

Because of the possibility of adverse weather conditions and in order to reconstruct the fuselage, the hundreds of pieces of wreckage were transported to a warehouse where CAB investigators worked to rebuild the aft fuselage structure in a mockup fashion by refitting each fragment into its original position of construction.

The mockup showed that the pieces were progressively smaller from all directions toward a point in the No. 4 baggage compartment.

Many pieces were mere fragments or were entirely missing in that area. This reconstruction and examination showed very conclusively that the aft fuselage disintegrated from extremely violent forces which originated in a very concentrated area within the baggage compartment below the aft buffet and just slightly left of the centerline of the aircraft. The forces were shown to have acted in all directions from this point.

These blew the cabin floor upward, the fuselage bottom shell outward, the aft bulkhead of the baggage compartment rearward, and its forward bulkhead forward. There is nothing in the structure of this part of the aircraft that could be the source of such an explosion.

The detailed examination of the aircraft wreckage disclosed no evidence of fatigue cracking, structural failure, or malfunctioning controls prior to the explosion. According to maintenance records of the aircraft covering its service history, it had been properly maintained. Pilot complaints had been corrected and there were no existing discrepancies affecting the airworthiness of the aircraft.

Engines Buried

The four engines and propeller hubs were found buried 6 to 10 feet in the two previously mentioned craters. All propeller blades were also recovered from these pits or from the immediate areas. The locations of these parts indicate that they remained attached to the two main pieces of the wing until ground impact. Examination of these badly damaged components disclosed no evidence which would indicate that any mechanical or operational difficulty was experienced with them prior to the start of disintegration of the aircraft.

Numerous pieces of the aircraft and its contents, bearing the sootlike smudges, were subsequently examined in the F.B.I. laboratory to determine, if possible, what type of explosive material caused the destruction of the aircraft. The chemical analysis revealed that the residues were those to be expected from the explosion of dynamite which contained sodium nitrate. The analysis further disclosed that the residues on many of the parts contained manganese dioxide, a major component of the mixture contained in dry cell batteries. Eleven pieces of material which could have origi-

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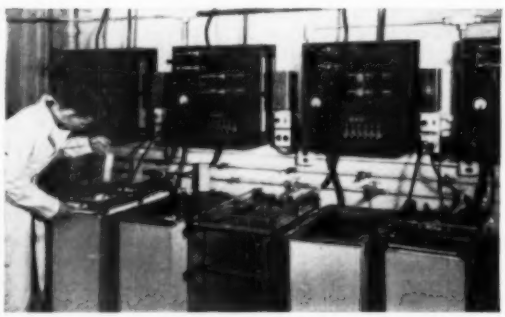

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nated from Everready "Hot Shot" battery were found. These items are two of the basic components of one type of a bomb.

During the investigation an extensive search for eyewitnesses was made and numerous persons were found who heard the explosion. Others were located who not only heard it but also saw it. Their descriptions fully agreed with the physical evidence. Several witnesses who saw the aircraft before the explosion stated it appeared to be climbing at an estimated altitude of 5,000 feet and the engines sounded normal. This, they added, was suddenly interrupted by a brilliant flash and followed by a deafening explosion.

The aircraft, in many parts, plunged to the ground where another explosion occurred. Flight tests showed that the altitude, course, and position of the flight when the explosion took place were normal for a routine operation.

Explosion Evidence

The evidence, and the analysis of the evidence in this case, pointed to the possibility of an explosion. In the first hours following the accident Board investigators had uncovered definite clues indicating that an explosive force, probably from within the aircraft but alien to it, had torn the aircraft apart in flight. Subsequently, by meticulously piecing together hundreds of pieces of the torn and shattered fuselage on a chicken-wire covered wooden frame mockup of the original DC-6B fuselage, Board investigators specifically determined that a dynamite-type explosion had occurred within the No. 4 baggage compartment of the airplane. Consequently, on November 7, six days after the accident, the Board notified the Denver office of the Federal Bureau of Investigation of its findings so that the apparent criminal aspects involved could be pursued immediately, a police function that is outside the Board's jurisdiction. Therefore, on the following day, Nov. 8, the FBI notified the Board's investigators that it would proceed with responsibility for the criminal portion of the investigation.

Analysis

As evidenced by the scatter of the aircraft wreckage and the practically vertical descent of the individual pieces, it is obvious that the aircraft disintegrated at an appreciable altitude. The relative locations of the pieces proved that the first occurrence in the sequence of disintegration was an extremely violent shattering of the aft fuselage with separation of the tail group. Without the tail the remaining aircraft structure probably pitched nose down and fell with uncontrolled gyrations during which the wing and forward fuselage separations occurred.

The reconstruction and examination of the aft fuselage proved that the forces which caused the initial disintegration radiated from a point within the number 4 cargo pit. The very pronounced intensification in severity of fragmentation from all directions toward this point proved that the disintegration of the aft fuselage was caused by an extremely violent explosion emanating from a very localized origin.

The violence was clearly shown by fragments which had been projected through the cargo compartment walls and ceiling

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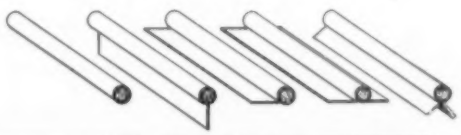

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as well as by tearing, denting and curling of adjacent structure. This evidence is in sharp contrast to the damage of an explosion resulting from the ignition of any combustibles carried on and used during aircraft operation. Laboratory analysis confirmed this and determined the explosive material was dynamite.

On Nov. 14, 1955, agents of the Federal Bureau of Investigation took into custody John G. Graham, the son of one of the passengers. Thereafter, he was indicted for acts leading to the destruction of the aircraft by means of a bomb explosion.

Findings

On the basis of all available evidence, the Board finds that:

1. The carrier, the aircraft, and the crew were currently certificated.
2. The flight was properly dispatched; the aircraft gross weight was under the maximum allowable and the load was properly distributed.
3. Takeoff was normal and the flight made reports in conformity to its instrument clearance.
4. At 1903, eleven minutes after departure, an inflight disintegrating explosion occurred aboard Flight 629.
5. The aircraft was climbing normally and was on course when the explosion occurred.
6. Physical evidence showed conclusively the explosion took place in the number 4 baggage compartment of the aircraft.
7. The violence of the explosion and the physical evidence proved the explosion was not caused by any system or component of the aircraft.
8. Physical evidence at the scene and laboratory tests confirmed that the explosive material was dynamite, in the form of a bomb.
9. There was no evidence found to indicate malfunction or failure of the aircraft or its components prior to the explosion.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was the disintegrating force of a dynamite bomb explosion which occurred in the number 4 baggage compartment.

By the Civil Aeronautics Board:

/s/ James R. Durfee
/s/ Joseph P. Adams
/s/ Chan Gurney
/s/ Harmar D. Denny

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of this accident on Nov. 1, 1955, shortly after it occurred. An investigation was initiated in accordance with the provision of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. The circumstances of the accident made a public hearing unnecessary and none was held.

Air Carrier

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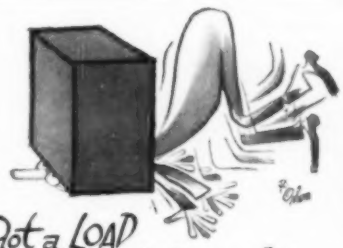

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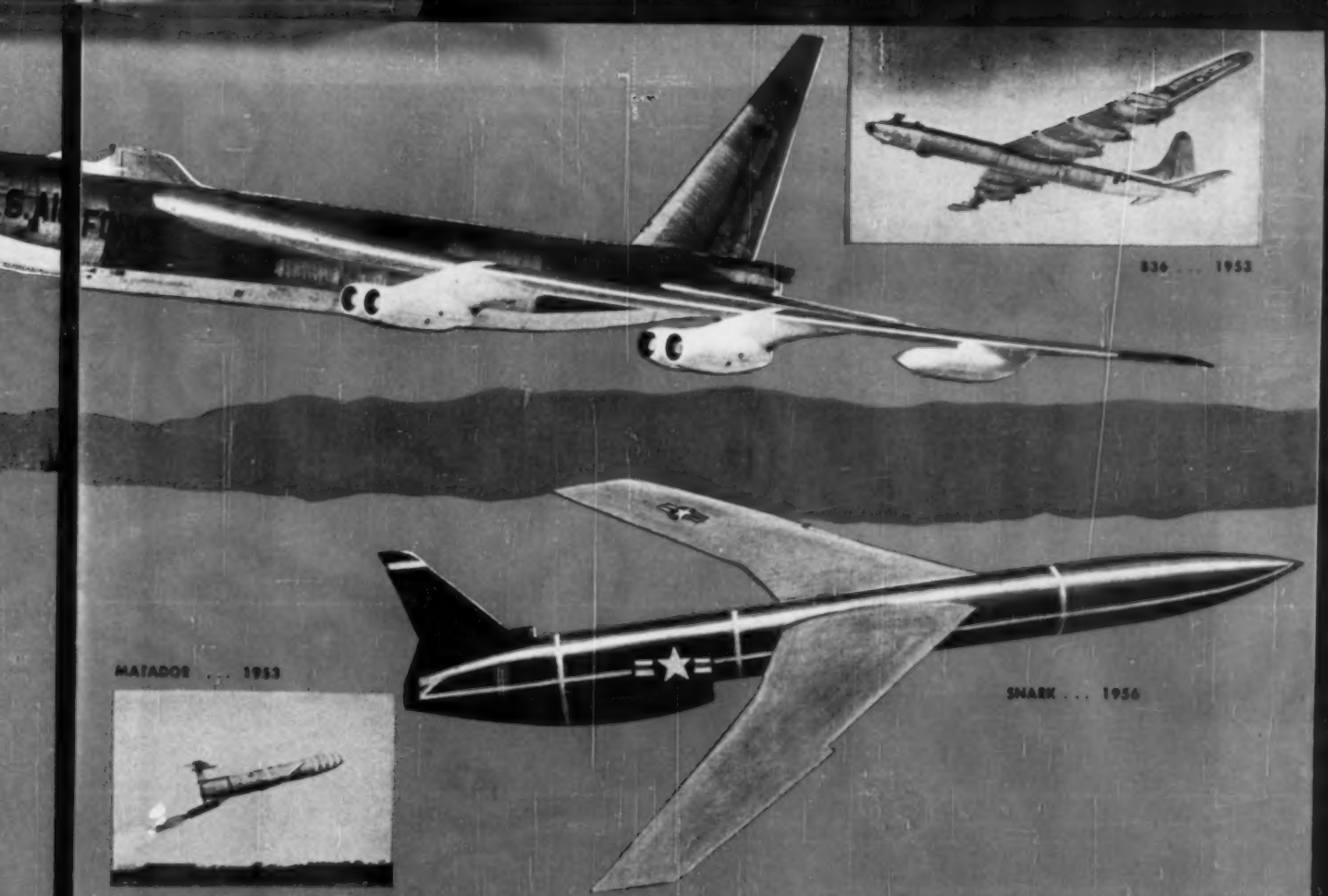

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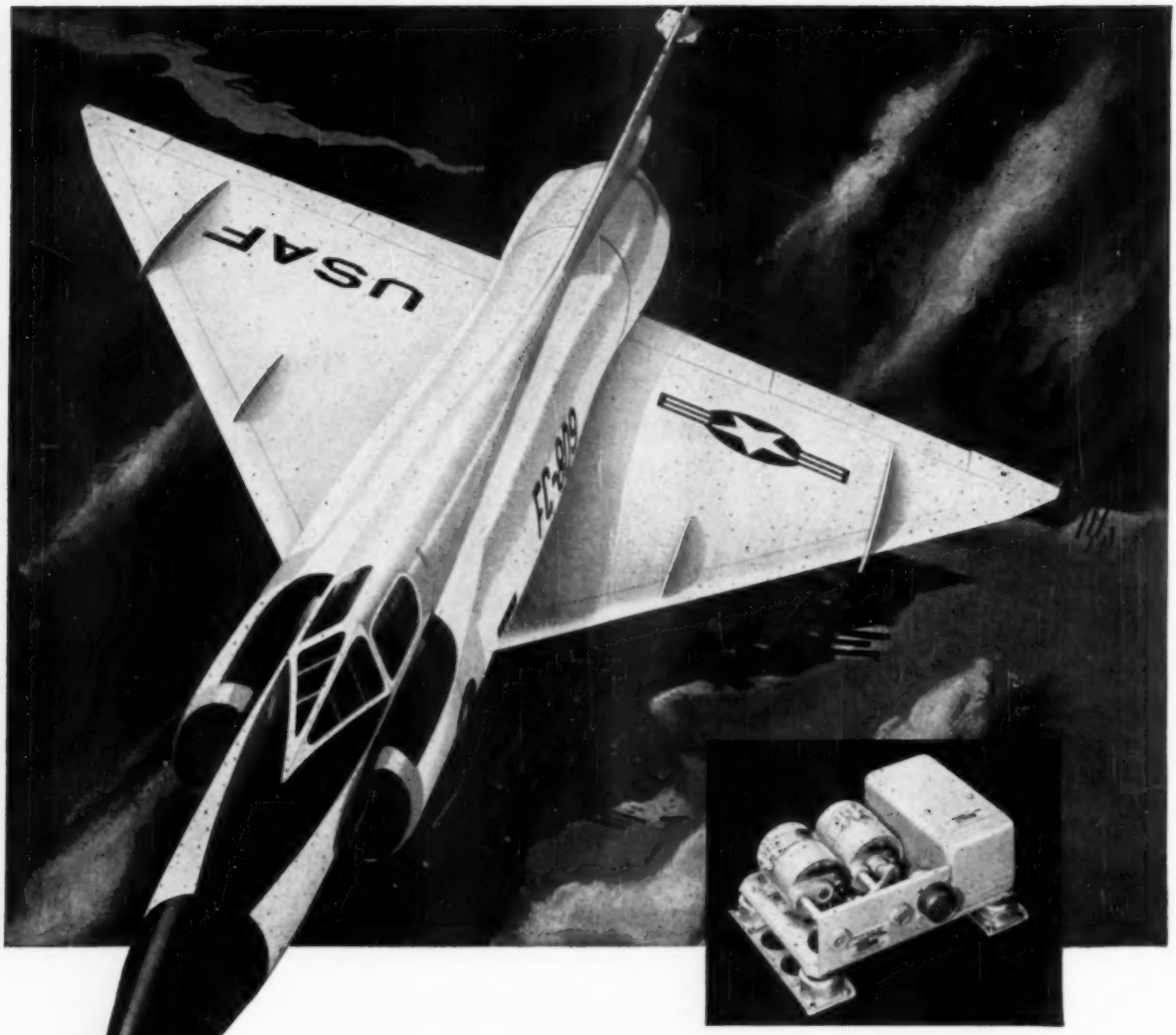

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Flight Personnel

Captain Lee H. Hall, age 39, had been regularly employed by the company since Dec. 1941. Official records of the CAA and the company indicate he had accumulated 10,086 flying hours, of which 703 were in the type equipment involved. Captain Hall possessed a valid air line transport rating, number 49477-40. His latest first-class medical certificate was dated Oct. 19, 1955; there were no waivers.

First Officer Donald A. White, age 26, was employed by United Air Lines on March 10, 1951. Appropriate records indicated he had accumulated 3,578 flying hours, 1,062 in the DC-6B. He held a valid air line transport rating, number 1021604. His latest medical was accomplished Aug. 3, 1955.

Flight Engineer Samuel F. Arthur, age 38, was a qualified first officer and flight engineer. He held a commercial pilot certificate, and a flight engineer certificate number 1124803. His total flying hours were 1,995, of which 336 were in DC-6B type aircraft.

Stewardess Peggy Lou Peddicord, age 22, received her training with the company and had been regularly employed since March 2, 1955.

Stewardess Jacqueline L. Hinds, age 26, was employed June 13, 1951, and, after regular stewardess training, served in that capacity with the company, assigned first to Washington, D. C., and after June 26, 1952, to Seattle, Wash.

The Aircraft

N 37559, a Douglas DC-6B, bore manufacturer's serial number 43538. It was owned and operated by the company and at the time of the accident had an aggregate of 11,949 flying hours, 133 since overhaul, 39 since last maintenance check, and 7 since the last thorough preflight. The aircraft was powered by Pratt and Whitney CB-16, R-2800 engines. The propellers were Hamilton Standard.

Garuda Airways Reports 28.5 Million Ton km. Flown

Djakarta, Indonesia—Garuda Indonesian Airways reports a total of 28.5 million revenue ton kilometers flown during 1955, the carrier's first full year of operation as a nationalized airline. The total represents a 24.5% increase over 1954.

GIA's present Indonesian management took over from KLM Royal Dutch Airlines in 1954, and its 1955 annual report is the first under the new setup. The report lists an available ton-kilometer total of 37.7 million for the year, up 14.2 over 1954.

The airline's load factor for scheduled services in 1955 was 74.2%, and for all commercial flights the load factor was 75.6%. GIA's fleet includes Convair 340, Convair 240, DC-3 and Heron aircraft.

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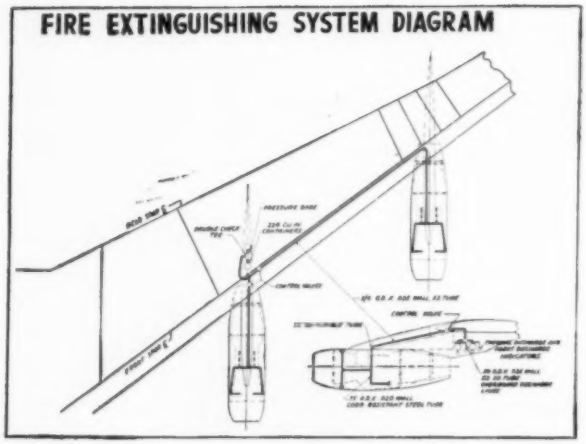
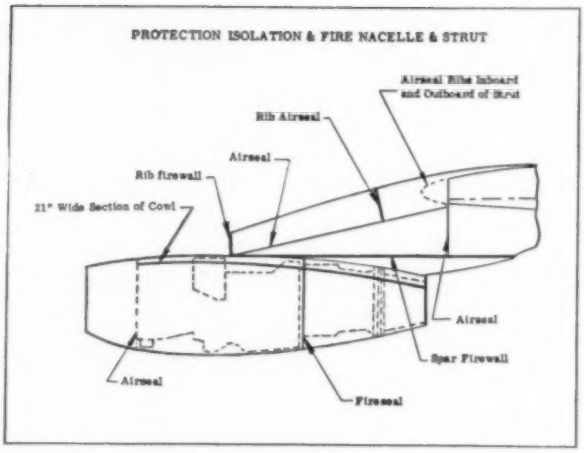




Fire Safety Built Into Boeing 707

By Glenn Garrison

Fire safety was a vital consideration in designing the Boeing 707 jet transport and was ranked equally with performance and economy, Boeing engineer Otto E. Kirchner, Sr. told members of the National Fire Protection Association at a recent aviation seminar in Boston.

Throughout the engineering of the 707, Kirchner said, the fire safety aspects were constantly coordinated, reviewed and checked against the best information available from all sources. Complete fire analysis data were recorded on all design decisions made in this area.

Among the safety features of the 707, according to Kirchner, are the following:

- Four single jet pods. The use of two dual jet pods to hold the four engines would have imposed a less severe aerodynamic drag penalty, but single pods were considered safer.
- Nacelle-to-wing attachments designed to break away in a crash landing without rupturing the integral fuel tanks.
- Rigid keel beam, 30 feet long and 14 inches deep, below wing center section to protect bladder cell tanks in the center section.
- Containment of electrical and electronic equipment in ventilated compartments to take smoke out of the airplane in the event of overheating.

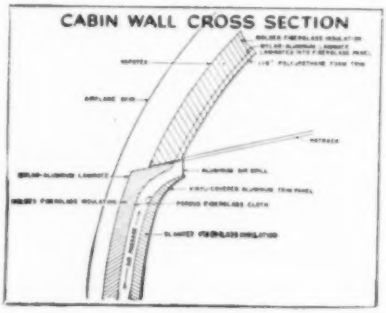
Great stress has been placed in the 707 design on passenger evacuation facilities.

To solve the problem of inwardly opening doors—desirable from a pressurization standpoint but more susceptible to jamming by passengers in an evacuation — the Boeing engineers have incorporated a unique mechanism in the main loading and servicing doors. These doors break open inwardly for about 20 degrees and then move outwardly for the rest of their travel. They can be operated from outside the aircraft by "T" handles.

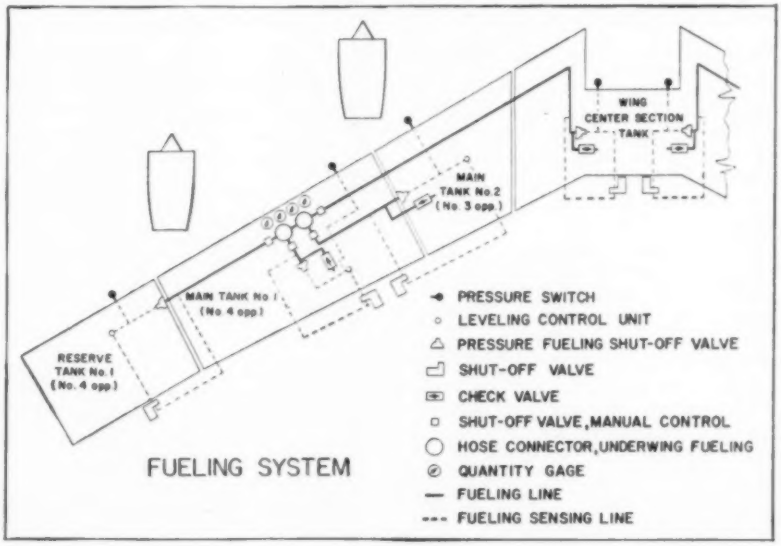
All doors and exits from the cabin are safeguarded against jamming caused by a reasonable amount of fuselage distortion, sealing vulcanization and the like by cams which can move the closure through the first half inch. Experience shows, Kirchner said, that a jammed door or exit will respond the rest of the way if moved that far.

Swept wing aircraft such as the 707 will require a somewhat different evacuation procedure than straight wing planes.

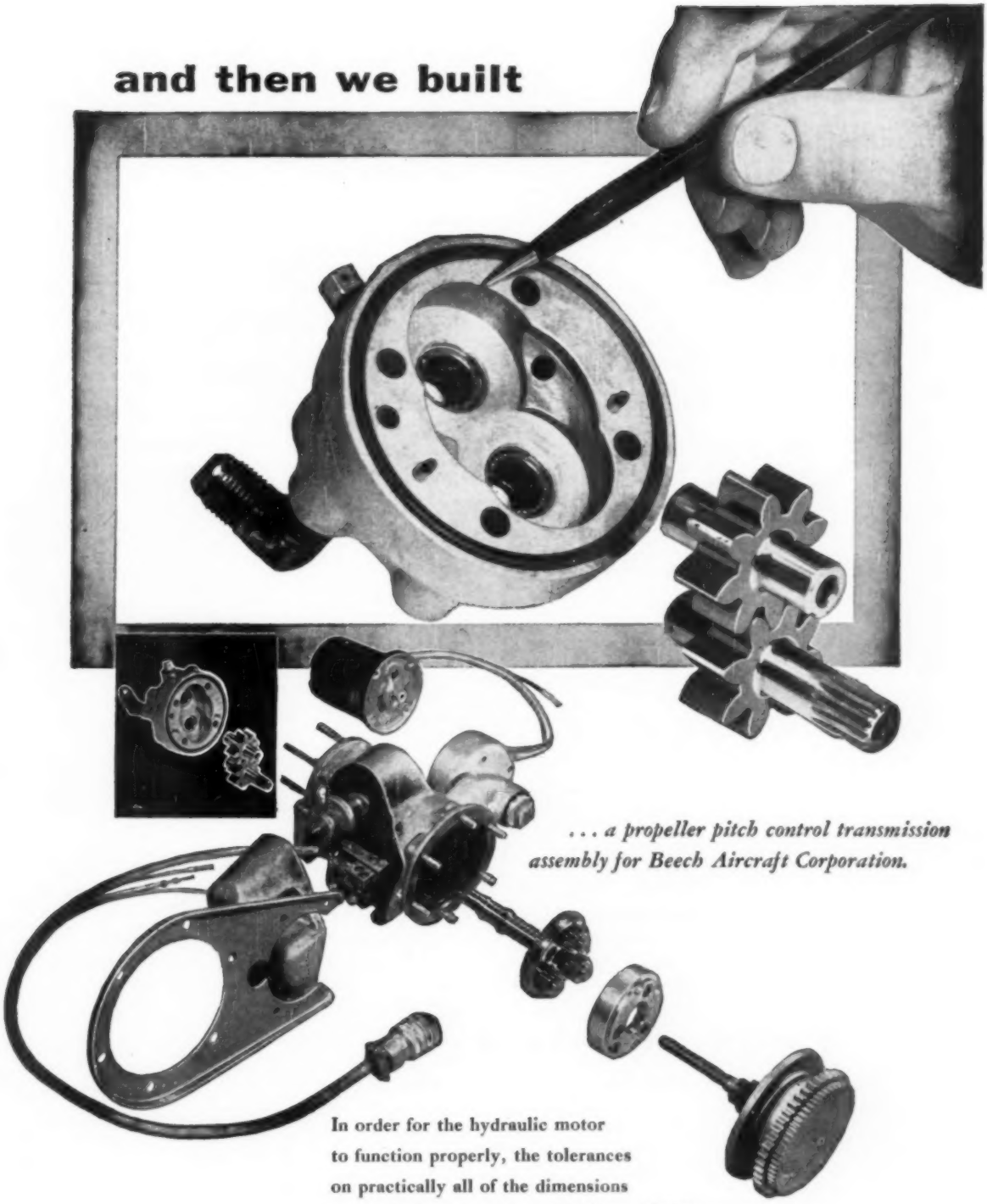
In the latter, engines and fuel tanks are about equidistant from front and rear doors, and choice of forward or rear evacuation depends on wind direction.



In the swept wing plane, fuel tanks are closer to the rear doors and forward evacuation should be made whenever possible.



and then we built



. . . a propeller pitch control transmission assembly for Beech Aircraft Corporation.

In order for the hydraulic motor to function properly, the tolerances on practically all of the dimensions had to be held to within .0001" or .0002" for squareness, parallelism and concentricity.

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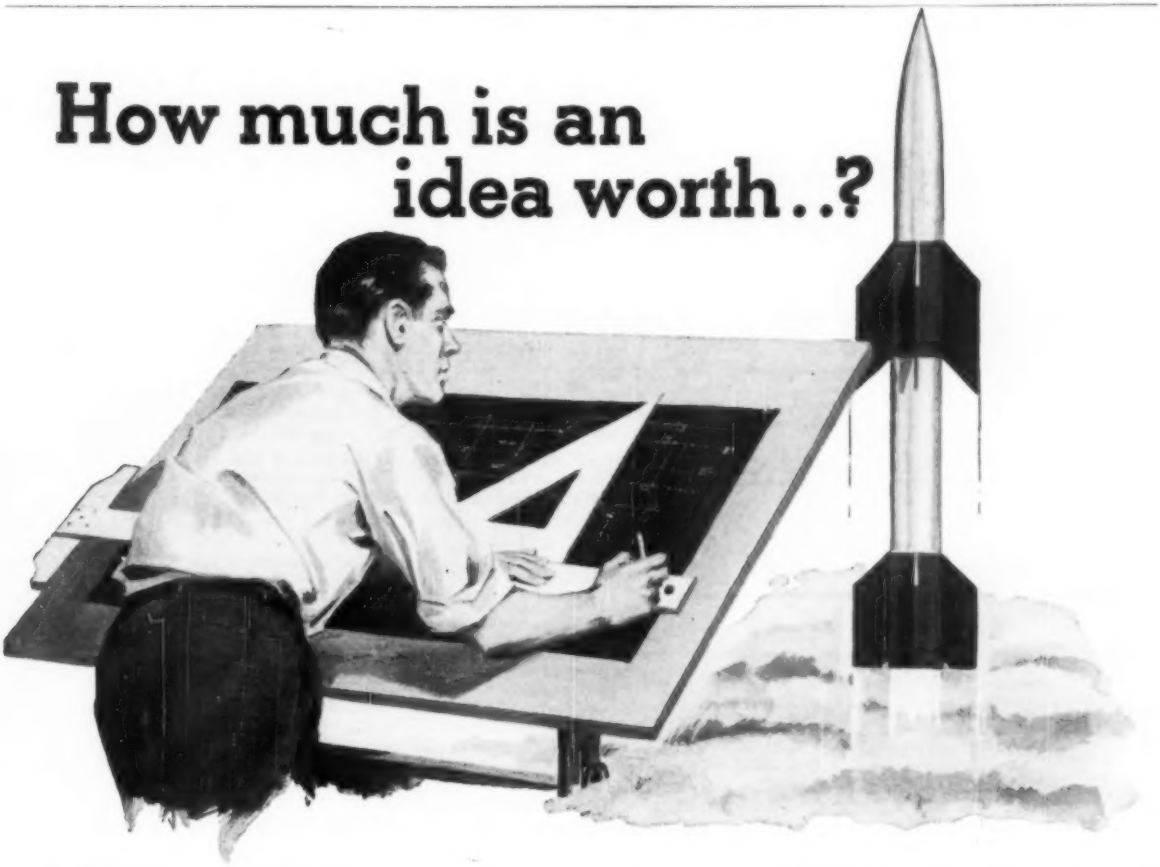

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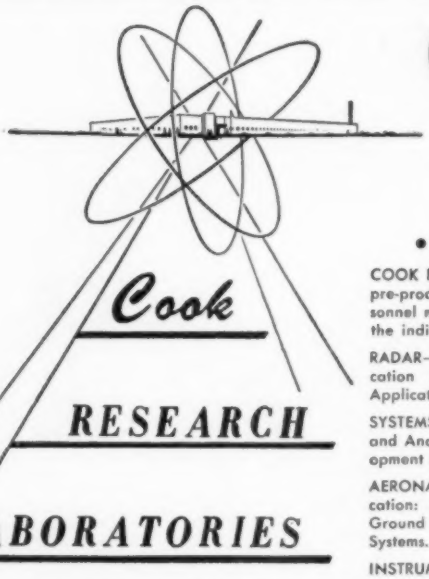

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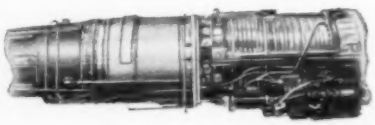

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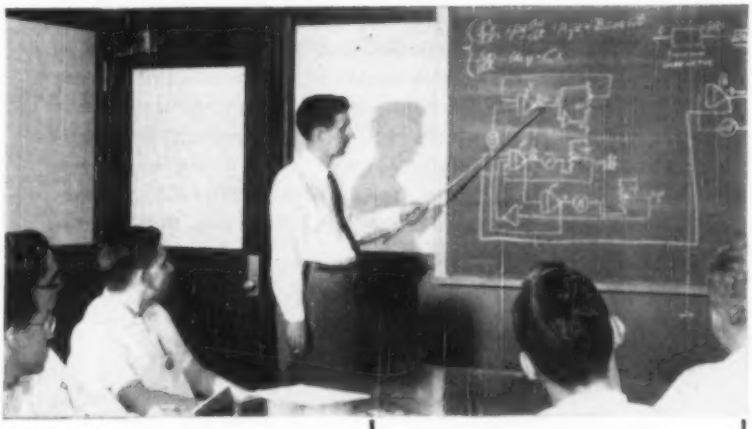

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SW-2070, Aviation Week
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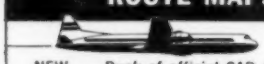

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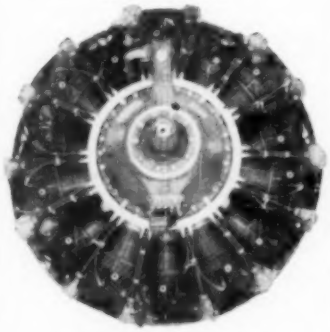

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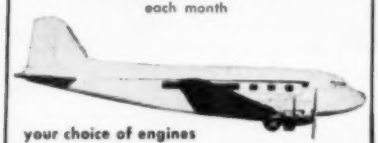

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LETTERS

Battle of Budget

You have carried the torch for additional appropriations for defense for so long that I am surprised to see the comments in Mr. Hotz's editorial in the issue of May 21.

It is difficult to reconcile Mr. Hotz's complacency in his statement, "The Fiscal 1957 battle of the airpower budget is virtually won." Ended it may be—but if it has been won, then I misunderstand the information in your excellent magazine and in the daily papers. Though enough criticism has been leveled at the Defense Department and the Administration to beget an investigation of the handling of aircraft procurement and to result in approval of additional appropriations for, among other things, B-52 procurement, it is noted that the low level of the 1957 Budget was achieved only through a variety of one-shot economies.

In an election year it is to be expected that Congress will hide its head in the pickle barrel instead of standing on it (the pickle barrel, that is), but does its excess of strategic information warrant:

1. Buying only 10 months aircraft production instead of 12 months. Is it really feasible to legislate reduced lead time into the production of aircraft?

2. Postponing necessary base and test facility construction. Our primary lead in airpower is in relatively short range B-47s dependent upon foreign bases. Completion of these bases was originally scheduled for 1957, later estimated in 1959, and now postponed until nobody knows when. The question may well be asked: Do we have adequate base facilities *now* for the types of aircraft in service, and will base construction parallel in availability the new types of aircraft as they are produced?

3. Slowing Research and Development. Are we really slowing down R & D or is it being buried like the CIA budget? If the latter, what control is being effected? If the former, and we are truly slowing down R & D, this appears criminally stupid in the face of foreign production of competitively superior aircraft, or it reflects what has been stated as an increasing shortage of engineering talent.

In the event that the engineering shortage is a priority problem, may I quote Industry Observer, the first paragraph from the same issue, which states that R & D funds are now available to award Phase I contracts for a medium-range interceptor as a result of a decision by USAF to cancel the long-range interceptor and fighter-bomber Phase II programs. It would be interesting to know the number of engineering hours spent by several competing companies in completing these canceled Phase I programs. It would be more interesting to know whether the newly appointed Phase I contractors for the medium-range interceptor will be the same companies, helping to utilize the many engineering hours already spent. Or will this priceless engineering expenditure follow the host of other unproductive programs that preceded it?

With industry crying for engineering talent, the need for more adequate planning to avoid such missteps must be obvious. Look for a moment at Ford Motor Co., which has recently announced an initial yearly expenditure of about $12 million in the area of control systems and electronics. What do you suppose Ford would offer for the engineering talent that is being thrown away on poorly planned programs that are canceled after a year? Perhaps they are making offers—higher offers—that cause increases in cost of Government and industrial R. & D. following the traditional laws of demand and supply.

No, Mr. Hotz, the battle of the budget is not won, and it goes much deeper than a $35 or $36 billion Defense Budget. The American public has not won any battles until it has won the battle of security at reasonable cost, and reasonable cost is far less than that indicated by the apparent wastefulness of engineering resources, lack of coordination of weapons with support, and pickle barrel thinking evidenced by legislating a two-month reduction in the time allowed to produce the weapons of defense.

AIRCRAFT WORKER

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Reeves Participation

In reading your interesting article on the subject of "Soviet Advances Force U.S. Missile Pace" (AW March 12, p. 98), I notice that you state on page 101 "a radar chain—first of its kind in this country—has been developed and installed for the Air Force by Reeves Instrument Corporation" and that "this down-range chain will link all tracking stations simultaneously, and collect, compute and present missile flight coordinates back at the firing point."

Although it is true that such a chain radar system has been put into operation at AFMTC, to the best of my knowledge, the extent of participation by Reeves Instrument Corporation in the program was in supplying and installing the tracking radars. In fact, the Reeves radars replaced modified World War II type SCR584 radars installed at Cape Canaveral and on various island instrumentation sites by the Electronic Engineering Company in 1952 and 1953.

The radar data is actually transmitted back to the firing point using equipment developed and manufactured by the Electronic Engineering Company of California. Computation and plotting of data is accomplished using the equipment supplied by Electronic Associates of Long Branch, New Jersey (no relation to our company). The data is actually transmitted over a submarine cable supplied by the Bell Telephone Laboratories. Another type of radar data is transmitted back to the main base using equipment developed by G. M. Giannini & Co., Inc., Pasadena, Calif., for computation using the AFMTC Flac High Speed Digital Computer developed by Air Force personnel at PAFB.

Your statement that this radar chain is the first of its kind in this country is not necessarily correct. The Electronic Engineering Company developed an automatic chain radar tracking system for the U.S. Navy at the Naval Test Center at Pt. Mugu, Calif. This system automatically positioned remote radars to locate targets and transmit the tracking radar data over radio links back to the launching area for automatic plotting. This system was put into operation in 1952. The AFMTC system, although considerably more complex, was largely patterned after the system we developed at Pt. Mugu, Calif.

R. B. BONNEY, Vice President
Electronic Engineering Company of California
180 South Alvarado St.
Los Angeles 57, Calif.

Service

I just read your article, "Why Engineers Change Jobs: More Money, Responsibility" and feel that you have done those of us in sales management a real service by pointing out how difficult it is to educate the entire engineering personnel in avionic companies. I am sure that AVIATION WEEK's media men as well as other magazine media men will pick up the fact that almost one out of every three engineers in avionics has been hired during the past year.

E. A. JOHNSON
Vice President, Sales
Barry Controls, Inc.
Watertown 72, Mass.

Appreciated

In contrast to the hysterical and unfounded statements of self-styled representatives of the engineering profession and management of firms employing engineers, your recent article in AVIATION WEEK was greatly appreciated.

Your analysis of the situation was a most enjoyable display of statistical data proving that the employers, and not the engineer, are engaging in the "grass is always greener" philosophy.

Here's hoping that you will go on and on in your separation of fact from fancy.

ROBERT P. GOLDSTEIN
1347 Shady Avenue
Pittsburgh 17, Pa.

Spotters Wanted

The International Aircraft Spotting Assn. has recently been formed and is in urgent need of new members in order that it may arrange for competitions. We hope to present the competitor with the highest individual score a trophy by the end of the year. We would be pleased to hear from any AVIATION WEEK readers who are interested in joining our association.

JEAN-MARIE COUSINEAU
Secretary-Treasurer
International Aircraft Spotting Assn.
14 Martineau St., Ottawa 2, Ont.

Bendix BRAKES WITH

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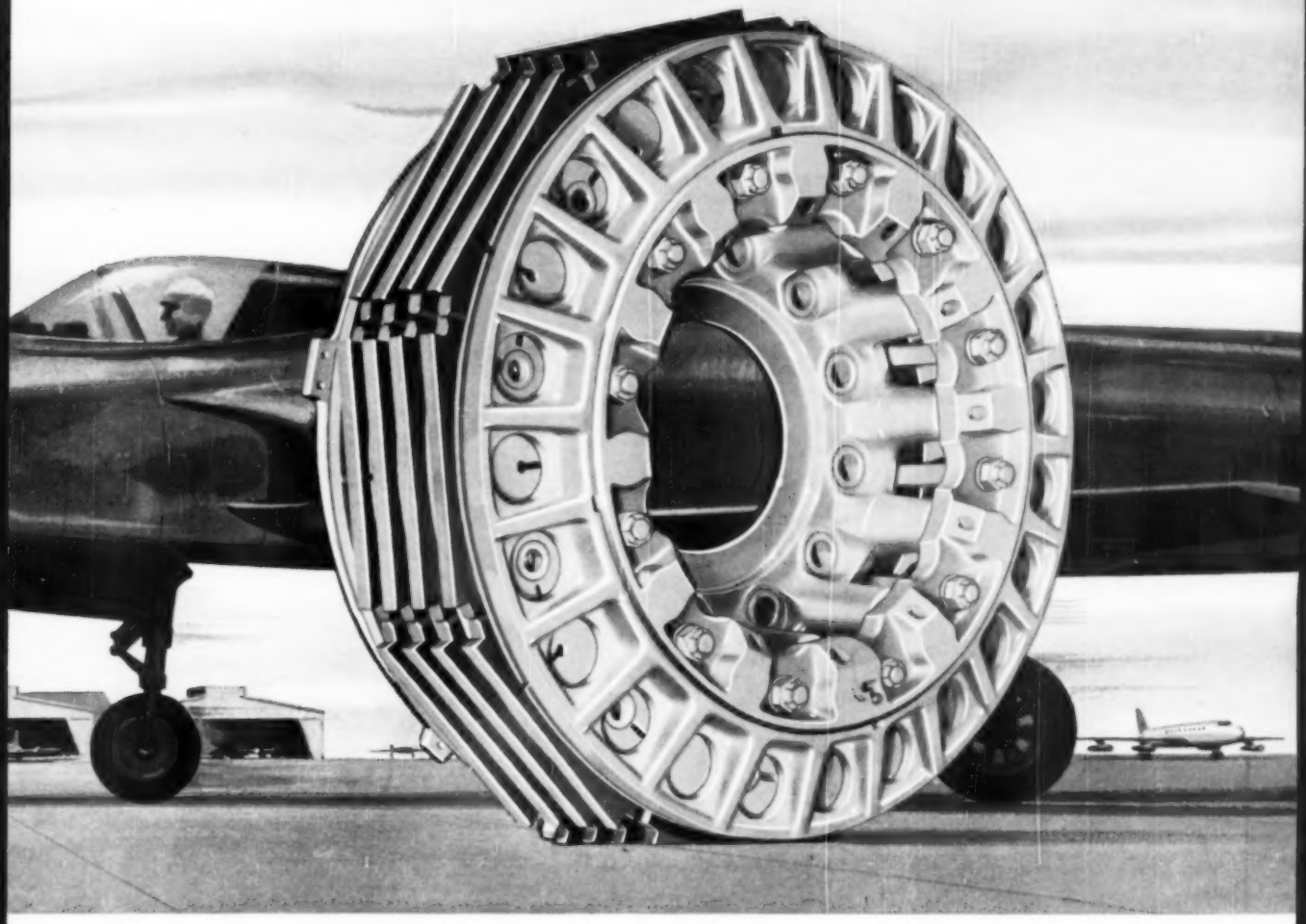

Here is an unbeatable combination—the Bendix Segmented Rotor Brake and Cerametalix† brake lining.

These two were made for each other—literally! For Cerametalix lining was developed by Bendix for use in Bendix† brakes; then, the brake itself was proportioned to take full advantage of this remarkable new kind of friction material.

NO FADE. The result is a brake that will not fade, fuse or lose friction, even under braking loads that heat the linings to incandescent temperatures!

LESS MAINTENANCE. Also, less time and expense are required for maintenance because adjustments are less frequent and linings last several times longer.

NO WARPING. The lining material itself is a good conductor of heat. This, combined with the exclusive Bendix segmented rotor construction, eliminates warping and welding of friction surfaces.

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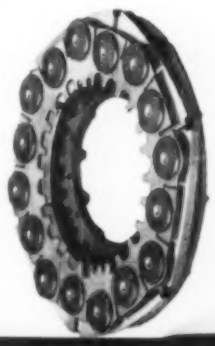

*CERAMETALIX Bendix brake stator faced with Cerametalix—an entirely different kind of friction material. Cerametalix is a sintered compound of ceramic and metallic ingredients that has amazing resistance to heat and wear. As a result, friction loading and energy absorbing capacity can be approximately doubled.

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For details on how Reynolds can serve you, write the *Reynolds Metals Company, P.O. Box 1800-TJ, Louisville 1, Kentucky.*

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Reynolds technical handbooks and 16mm. movies can contribute immeasurably to your training program and reference files. Write to the address above for complete index and details about this material. Much of it is available without cost.

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